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# Point Source Analysis. Inventory, Water Demands, and Problem Area Identification. (Areawide Waste Treatment Management Plan for the Greater Houston Area. Section 208, PL 92-500)

**Houston-Galveston Area Council, Tex**

Prepared for

**Environmental Protection Agency, Washington, D.C.**

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# POINT SOURCE ANALYSIS

# INVENTORY, WATER DEMANDS, & PROBLEM AREA IDENTIFICATION

JULY 1977

HOUSTON-GALVESTON AREA COUNCIL

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Barnard Johnson, Inc.

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**9. Performing Organization Name and Address**
Bernard Johnson, Inc.
5050 Westheimer
Houston, Tx 77056

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Houston-Galveston Area Council
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2. The listing of existing water supply plans and projections of future water use, &
3. The definition of problem areas determined by comparison with existing State stream standards.

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# POINT SOURCE ANALYSIS

## INVENTORY, WATER DEMANDS, &
## PROBLEM AREA IDENTIFICATION

AREAWIDE WASTE TREATEMENT MANAGEMENT PLAN
FOR THE
GREATER HOUSTON AREA
(SECTION 208, PL 92-500)

JULY 1977

PREPARED FOR THE HOUSTON-GALVESTON AREA COUNCIL
BY
BERNARD JOHNSON, INC.

# FOREWORD

This document (with the exception of Chapter 3, Appendix B, which was prepared by the Houston-Galveston Area Council) has been prepared by Bernard Johnson, Inc., as part of the Point Source Analysis contract with the Houston-Galveston Area Council (H-GAC) as required by the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500). The H-GAC has been designated as the planning agency to develop an areawide waste treatment management plan under Section 208 of P.L. 92-500 for the Greater Houston Area.

Please be advised that the data contained herein is such that updating and revision will be necessary as new information is generated and changes occur in the growing Houston area.

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# CHAPTER I - POINT SOURCE INVENTORY

# CHAPTER I - POINT SOURCE INVENTORY

## Introduction

### Purpose

The point source inventory phase of the point source analysis was designed to locate and characterize significant industrial point source dischargers of wastewater within the Houston 208 planning area. In so doing, the data base required as input to other 208 tasks within the point source analysis was established. This data base serves as a direct input to Task 15-III (Industrial Wasteload Projection) and to Task 15-IV (Definition of Point Source Problems). A further purpose of this task has been to synthesize municipal point source and sludge inventories performed by other 208 study groups.

### Scope

Information on point source dischargers was inventoried in three categories. The first category, identification, includes the following:

1. Name of Permit Holder
2. Plant Name
3. Waste Control Order (WCO) Number
4. National Pollution Discharge Elimination System (NPDES) Permit Number
5. Name of Contact Person
6. Telephone Number
7. Standard Industrial Classification (SIC) Number

The second category, location, includes the following information:

1. Geographical Coordinates

2. Stream Segment Number
3. Stream Index Number
4. Subbasin Number
5. Census Tract Number
6. Discharge Route

The final category, characterization, consists of other information needed to describe the activity related to the discharge and includes the following:

1. Treatment Process Description
2. Type of Wastewater
3. Treatment Plant Capacity
4. Population Served
5. Construction Date of Treatment Facility
6. Planned Improvements
7. Compliance Schedule
8. Enforcement Orders
9. Permit Limitations
10. Performance Data
11. Production Data
12. Flood Plain Information

Wherever the information was available, it was recorded, compiled and included in the point source inventory. For many point source discharges, all of the information was not available. In cases where the information could be approximated, this approach was taken. In cases where approximation was not feasible, the information was omitted. A more detailed discussion of these cases is presented in the section of this report which describes the industrial, municipal, and sludge inventories.

Outputs from the inventory phase include this text plus point source location maps, a storage/retrieval program, a program users guide, and inventory printouts.

## Organizational Approach

Four organizations have worked directly on the point source inventory. Gulf Coast Waste Disposal Authority (GCWDA) compiled the inventory of sludge and residual waste production and characteristics. The City of Houston compiled the inventory of municipal point source discharges. Bernard Johnson Incorporated (BJI) compiled the inventory of industrial point source discharges both to surface waters and to municipal sewer systems. In addition, BJI has reviewed the inputs from GCWDA and the City of Houston, computerized the municipal and industrial point source inventories, located the municipal and industrial point source discharges on base maps, and prepared the point source inventory report. Houston-Galveston Area Council (H-GAC) is the management organization for the project and has coordinated the inputs of the other organizations and computerized the GCWDA sludge inventory.

## Description of Inventories

### Industrial Inventory

The main sources of input information for the industrial inventory were the permit files of EPA, Texas Water Quality Board (TWQB), and the Public Works Departments of 208 area cities. TWQB files provided information on industrial discharges to surface waters, and the Public Works Departments provided information on industrial discharges to municipal sewer systems.

Within the TWQB permit files, information was generally found in one of several documents. These documents included the WCO permit, the NPDES permit, the Army Corps of Engineers permit, the NPDES permit application, and staff reports compiled by TWQB District 7 personnel.

Correspondence with the Public Works Departments of several cities within the 208 area revealed that only the City of Houston has major industrial wastewater discharges to their municipal sewer system. Approximately 70 such discharges are identified by the City of Houston in their NPDES permit application. The term "major" is defined by the City of Houston as (a) a flow of more than 50,000 gpd, (b) a flow greater than 5% of the flow carried by the receiving sewer line, or (c) toxic pollutants in significant amounts to impact the treatment works or effluent quality.

Other sources of information were also employed. The 1972 Standard Industrial Classification Manual and the 1975 Texas Manufacturers Directory were used to verify product information, SIC number, plant name and address, and contact person. Maps provided by H-GAC which delineated census tracts, stream index numbers, and subbasins were also employed. To document effluent quality, a TWQB computer printout of self-reporting data from June 1975 through January 1976 was employed. This printout represented the most recent and comprehensive self-reporting data.

Data Analysis. The data was synthesized into a form acceptable for computerization and useful as an input to future tasks. This involved summarizing the data and eliminating superfluous information. In many instances it involved using information from other sources such as the Manufacturers' Directory to augment the permit information. Following is a discussion of this analysis by information category.

1. Identification Information: - The name of the permit holder was taken from a TWQB computer printout listing industrial WCO holders within stream segments of the 208 area.

The plant name was, whenever available, taken directly from the TWQB printout. In other cases, it was obtained from the 1975 Texas Manufacturers' Directory.

The recorded address was taken from the TWQB computer printout and generally represents a mailing rather than street address.

The WCO number was taken from the TWQB printout and verified in the permit files. The WCO number includes both the plant WCO number and the outfall designation. For industrial discharges to the City of Houston sewer system, the WCO number listed is the WCO from the City of Houston sewage treatment plant which accepts and treats the industrial wastewater.

The NPDES number was taken from TWQB and EPA permit files. In some cases, no NPDES permit number was available, indicating that the permit was yet to be issued. No NPDES number is shown for industrial discharges to the City of Houston's sewer system.

2. Location Information: - Geographical coordinates of the discharge point were found in one of three sources: Army Corps of Engineers permit, the NPDES permit application, or the Thirteen County Sewer Plan prepared by H-GAC. In cases where these sources were either inadequate or unavailable, the coordinates

were ascertained using the plant address, tax maps and/or discharge route information. No geographical coordinates were available for discharges to the City of Houston sewer system.

The discharge route was generally taken directly from the WCO permit. In cases where no discharge route was specified in the permit, the discharge route was obtained from the discharge point location map. For discharges to the City of Houston sewer system, the name of the sewage treatment plant receiving the wastewater was recorded.

A stream index number is a 15 digit number for each water course within the State of Texas. Index numbers for 208 area discharges were determined from stream index base maps and discharge point location overlays. Stream index numbers for discharges to the City of Houston sewer system refer to the discharge point of the sewage treatment plant.

Census tract numbers were determined using base maps, with discharge point location overlays and census tract delineation overlays. The census tract number presented in the computer printout is a 4-digit designation in which the first two digits identify the county. Census tract numbers for discharges to the City of Houston sewer system refer to the discharge point of the sewage treatment plant receiving the wastewater.

3. Characterization Information: - The treatment process description refers to those unit processes that are employed to treat both wastewater and resulting residuals before discharge to either surface waters or to a municipal sewer. For computer application, the unit processes have been coded using two and three letter designations. The information on treatment process came from TWQB permit files. Treatment information on discharges to the City of Houston sewer system is limited to whether or not pretreatment is provided.

The type of wastewater present in each permitted outfall was determined from TWQB permit files. For computer application, this information was coded in the same manner as the treatment process designation. In many instances, the type of wastewater is either not available or is not discernible by outfall.

The compliance schedule gives the date on which the discharger must comply with the effluent quality parameters stated in his permit. Compliance dates were obtained directly from the WCO permit.

Enforcement orders are occasionally established by TWQB for the purpose of enforcing and monitoring compliance, especially if a history of non-compliance exists. Details of the TWQB enforcement orders are available in the permit files. Enforcement order numbers are presented in the industrial inventory computer printout. Whenever no compliance schedule is stated in the computer printout, it is because no information on a compliance schedule was available in the permit files. The word "none" in the computer printout indicates that the discharge is not subject to a compliance schedule.

Specific permit limitations are stated within both the WCO and the NPDES permits. These limitations define the maximum pollutant concentrations or loads that a permit holder is authorized to discharge from an outfall. In many instances a maximum concentration is stated. In other instances a maximum load is stated. These limitations are permitted as average daily values, daily maximum values, or both. A wide variety of parameters are covered with BOD, TSS and COD being the most common. Flow rate limitations are stated for all discharges except those consisting primarily of stormwater. For many outfalls, the permit limitations are scheduled to change at some future date. When domestic sewage is present in a discharge, a chlorine residual and a coliform number limitation is included in the permit.

When recording permit limitations on the computerized storage system, an attempt was made to summarize the permit data, to eliminate unnecessary repetition, and to present the specific parameter limitations in their permit form. In cases where a concentration rather than a load limitation was permitted, this value was recorded. In addition, other parameters were stated if (1) they related directly to the type discharge (e.g., zinc from a plating operation), or (2) no limitations were available for BOD, TSS or COD. For several outfalls (those containing only uncontaminated cooling water or stormwater runoff and those specifying no discharge), there were no specific parameter limitations stated in the permit. Also, permit limitations for industrial discharges to the City of Houston sewer systems were not available in the NPDES permit application.

The most comprehensive performance information comes from TWQB self-reporting data. A printout of such data was obtained which presents daily average values for flow, BOD, TSS and COD by month for the period from June 1975 to January 1976. The mean values from this printout were recorded in the industrial inventory to document the discharge characteristics of outfalls which discharge directly to surface waters. Because many dischargers did not report performance data on some outfalls, performance for all outfalls was not documented. The quality characteristics for industrial discharges to the City of Houston sewer system were available in terms of concentration and have been reported in this form.

Production data is limited to a listing of the products manufactured or the services provided. Quantitative information on products and services are either unavailable or out of date.

Summary. The industrial inventory provides three categories of information on two types of discharges. The information categories are (1) identification, (2) location, and (3) characterization. The types of discharges are (1) discharges directly to surface waters, and (2) discharges to municipal sewer systems. The major data sources are TWQB permit files and the Public Works Departments of area municipalities. Data has been presented in its original form whenever possible. Evaluation and analysis of data was performed in order to eliminate superfluous information.

## Municipal Inventory

The City of Houston prepared an inventory of municipal point source dischargers in fulfillment of the requirements of Activity 3 of the H-GAC 208 program. This inventory served as the primary data base for developing the computerized storage/retrieval system and point source discharge location maps.

Data Analysis. The municipal inventory incorporated into the storage/retrieval system and the discharge points were plotted on location maps. Generally, the data received was incomplete, and much information was missing. Following is a discussion, by information category, of the municipal inventory data sheets.

1. Identification Information: The name of the permit holder was included on all inventory sheets and was transferred to the storage system. The plant name was included in the majority of the inventory sheets. In all critical cases (i.e., where one institution holds the permits for several plants) a plant name was included and was placed in the storage system.

Whenever the address of the permittee was included in the data, it was incorporated in the storage/retrieval system. In many instances it was not available and an alternative address, such as the address of the law firm representing the permittee, was recorded. In several instances no address was available.

The WCO number is a critical item which was taken directly from the data sheets and verified using a TWQB printout of self-reporting data. The WCO number was almost always included in the data sheets and generally corresponded with the number from the TWQB printout. The NPDES number was missing from a large number of the data sheets.

Since several contact people and phone numbers were given in the data sheets, an attempt was made to record the most appropriate contact person and phone number. The order of preference for these items was (1) name of permittee, (2) name of owner, (3) name of operating entity, and (4) name of consulting engineer. In several cases, either no contact person was named or no phone number was listed and this item was omitted from the inventory.

2. Location Information: Geographical coordinates of the discharge point were included in the majority of the data sheets. Where available, these coordinates were recorded and the discharge point was plotted on location maps according to these coordinates. In cases where coordinates were not included, the discharge route was used to aid in the plotting process. While this route does not pinpoint a discharge, it is a readily available and easily used tool for rough checking the validity of the coordinates. The discharge route was included in the majority of the data sheets. However, it is not a specific enough piece of information to be used for anything more than a rough check on geographical coordinates.

The stream segment number was missing from a majority of the data sheets. Since this is a recall item, its identification is critical. Stream segment numbers were ascertained using a TWQB listing of the WCO permit holders within the 208 area.

Census tract numbers were generally included on the data sheets whenever the geographical coordinates were included. In these cases, the census tract numbers were incorporated into the storage/retrieval system.

3. Characterization Information: The treatment process description refers to those unit processes that are employed to treat both the wastewater and the resulting residuals before discharge to surface waters. For computer application, the unit processes have been coded using two and three letter designations. Approximately half of the data sheets included no information on the treatment process.

Whenever included in the data sheets, the treatment plant capacity has been recorded in the storage/retrieval system as million gallons per day (MGD). Capacity information was lacking from a significant number of data sheets.

The number of persons served by a plant was either missing or presented in terms of number of connections for over half of the plants listed on the data sheets. Population served has been recorded in the storage/retrieval system for those plants where it was stated in terms of population on the data sheets, otherwise it has been omitted.

The construction date of the treatment facility has been recorded as either the year or the month and year that the plant was constructed. This information was lacking on the majority of the data sheets.

Where planned improvements have been clearly documented on the data sheets, they have been recorded in the storage/retrieval system. When it was explicitly stated that no improvements were planned, the word "none" was entered. Information on planned improvements was lacking from approximately half of the plant data sheets.

WCO compliance schedule information received on data sheets was often vague. In some instances, compliance dates were given and have been recorded. For plants where numbers appeared but were not accompanied by dates, the word "yes" was entered in the computer storage system under the assumption that the numbers represented some sort of effluent limitation. In the storage system, the word "none" indicates that no compliance schedule applies. A significant percentage of the plant data sheets contained no compliance schedule information.

Enforcement order numbers were generally lacking on the plant data sheets, although brief descriptions of the problem precipitating the order were often included. Wherever enforcement order information was stated, whether it was a description or an order number, it was recorded in the storage/retrieval system. In many instances the authority issuing the order was not identified. In the storage system, the word "none" indicates that no enforcement order applies. Most of the plant data sheets contained no enforcement order information.

The most comprehensive performance information comes from TWQB self-reporting data. Since no performance information was included on the plant data sheets, the most recent TWQB self-reporting data was used. The data contains daily average values for flow, BOD, and TSS by month for the period from June 1975 to January 1976. The mean values from this printout are recorded in the storage/retrieval system to document the discharge characteristics of municipal wastewater treatment plants. Because many dischargers did not report performance data to TWQB, the inventory does not document performance for all outfalls. Flow is listed as million gallons per day, and BOD and TSS are listed as lb/day.

Permit limitations are not included on the plant data sheets. However, permit limitations are available on the TWQB printout used to record performance data. The permitted flow is presented as MGD while BOD and TSS are presented as lb/day. Since this permit information is recent, readily available, and in a form compatible with the performance data, it is recorded in the storage/retrieval system to document effluent limitations.

On approximately half of the data sheets, flood plain information was included and has been recorded. This information consisted of a statement as to whether or not a portion of the site lies within the 100 year flood plain.

Information on operational problems such as infiltration/inflow and bypassing were included on many of the plant data sheets. These items are recorded in the storage/retrieval system.

## Sludge Inventory

The inventory of sludge production, characteristics, handling, and disposition from point source dischargers was compiled by the Gulf Coast Waste Disposal Authority. This inventory has been received through H-GAC in two components: (A) Solid Waste Site Survey and Report, and (B) Municipal and Industrial Sludge Inventories. Following are descriptions and an analysis of these two submittals.

Solid Waste Sites. The Solid Waste Site Survey and Report is a report which inventories the existing industrial, commercial and municipal solid waste disposal sites within the 208 area. It is presented in its entirety as a separate document. The report consists of: (1) an introductory narrative outlining the purpose and scope of the report and briefly discussing the report background, (2) a report methodology ex-plaining the survey procedures and forms, (3) a brief discussion summarizing area solid waste sites, (4) a summary tabulation listing the sites by category (commercial, municipal, and industrial) and presenting selected characteristics of each site, and (5) a presentation of the completed survey forms. A location map which was mentioned in the report was not provided.

The survey forms were analyzed for completeness in the perspective of the following questions.

1. Is the site adequately identified by name, address, permit number, contact person, etc.?

2. Has the site been located on a map and has such information as geographical coordinates, segment number, stream index number, census tract number, etc., been provided?

3. How well has the site been characterized by material handled, site size and capacity, relationship to waste sources, control measures, etc.?

Site identification information was generally complete. The facility name and address was always provided, and was often accompanied by directional information. Permit type and number were generally provided. The operator was identified for almost all sites.

Location information consisted mainly of location maps. No information on census tract, segment number or stream index number was provided. If these sites are to be categorized by some water quality or planning area, additional effort will be required to define the location.

A considerable amount of information was provided regarding the characteristics of the site, the control measures employed, and the type of material handled. The type of waste and total quantity handled by the site was provided. However, when more than one type of waste was received, the quantity attributed to each type was generally not provided. The site size and capacity was well documented. The size, life expectancy, and land remaining were stated, and a usage rate was given in acres/year. In many cases the usage rate was either not given or termed N/A. The relationship to the nearest water source was qualitatively stated. The distance to the water course was usually given.

In summary, the report provided a considerable amount of useful information needed to identify and characterize the solid waste sites. Its shortcomings are that it does not include complete locational information, the origin of wastes are not given, the quantities of individual types of waste are often lacking, and the quantitative relationship between the site, the control measures, and the nearby water courses is not explained.

## Municipal and Industrial Sludge Inventories

1. Industrial Sludge Inventory: The Industrial Sludge Inventory was received as a computer printout with no narrative. The printout included: (1) the I.D. number, (2) the manufacturer's name and address, (3) the contact person, (4) the local phone number, (5) the residual quantities in lbs/month for liquid and slurry in Classes 1 and 2, and (6) the number of shipments per month.

The information does not lend itself to analysis. It contains no location information and therefore presentation using maps is not possible. The disposal point is not identified, and only the number of shipments per month is stated. Performance information is limited to lbs/month by type of sludge. The information presented is useful from the standpoint of identifying the origin and relative quantites of sludge. However, it presents no information regarding the handling and final disposal point of the sludge. The industrial sludge inventory is presented in computer printout form and is available at H-GAC.

2. Municipal Sludge Inventory: No narrative was included. The printout was received in three sections: (1) identification, (2) characteristics and location, and (3) summary by stream segment.

The identification section was complete. The facility generating the sludge, its WCO number, and the permit holder's name and address were given. In addition, the name of a contact person and their phone number were listed for the majority of the facilities.

The second section presented location information for the sludge generating facility and the sludge disposal site in addition to sludge quantity and sludge facility information. The sludge generating facility was identified by WCO and facility name; location information was limited to stream segment. The facility was characterized in terms of flow in MGD, type of sludge facility, sludge quantity reported, and an estimate of the sludge quantity produced. The sludge disposal site was identified by name; location information consisted of geographical coordinates and stream segment.

The summary section listed the total flow, the sludge generated, and the sludge disposed of per stream segment.

The identification information was adequate; the location and characterization information was not complete, but was superior to that presented in the industrial sludge inventory.

Since geographical coordinates are given, the disposal locations could be plotted. However, if they are to be categorized other than by stream segment (such as by census tract) additional location information will be required.

Although a considerable amount of useful information is presented in the Municipal Sludge Inventory, it is often undefined and somewhat incomplete. It needs clarification and expansion. The municipal sludge inventory is presented in computer printout from and is available at H-GAC.

## Storage/Retrieval System

### Scope

Information on industrial and municipal point source discharges has been gathered and compiled in tabular form. This information falls into three categories: identification, location, and characterization. The information within each category has been discussed in detail earlier in this report. The method used to store and retrieve the information is presented as follows.

The information storage/retrieval system must serve two functions. First, it must be able to serve as an inventory of point source discharges within the Houston 208 planning area. To accomplish this it must present information in a suitable form and store it in an efficient manner. As part of this requirement it must allow data retrievable by categories. Census tracts, stream segments, subbasins, and SIC codes have been chosen as retrieval categories. In addition, the entire inventory is designed for retrieval alphabetically by name of permittee or numerically by WCO number. The second function of the data is to serve as an input to future tasks in the 208 planning effort. The data can be used as a base when projecting wasteloads and planning wastewater handling facilities. In fulfilling the second function, the data includes information which is relevant to wastewater facility planning as defined in the project design report.

### Description of Inventories

Industrial: There are more than 320 permitted industrial wastewater dischargers within the Houston 208 planning area. Approximately 250 of these dischargers are TWQB permitted outfalls which discharge directly to the surface waters of the area. Approximately 70 of these dischargers are permitted by the City of Houston and discharge to the City of Houston's sewer system.

Whenever a printout is ordered, it will include introductory information and self-reporting data totals. The introductory information briefly describes each inventory item and provides a key for coded items. The self-reporting data totals for all discharges within the recall item are presented in terms of flow, BOD, TSS and COD. These totals do not include discharges to the City of Houston sewer system.

If a complete listing is desired it can be obtained by selecting one of two possible ordering items. The available ordering items are name of permittee (for alphabetical listing) or WCO number (for numerical listing).

Recall items include census tract number, stream segment number, subbasin number, and SIC number. Census tract numbers are presented in Table I-1. Stream segment numbers are presented in Table I-2. Subbasin numbers are presented in Table I-3. SIC numbers are presented in Table I-4. A listing of all permittees within a given recall item number can be generated. For instance, if one desires to know all the discharges occuring within stream segment 1006, choose stream segment as the recall item and 1006 as the recall item number.

The stream segment numbers, census tract numbers and sub-basin numbers associated with discharges to the City of Houston sewer system refer to the location of the sewage treatment plant which treats the wastewater. Consequently, the information included on these discharges will be included on a printout when the recall item associated with the appropriate City of Houston treatment plant is requested. Remember that no self-reporting totals will be printed out for these discharges.

An added feature of the inventory is that it permits the operator to print out both SIC number and subbasin number simultaneously. Hence a printout can be generated which lists the SIC numbers within a given sub-basin and vice versa.

Municipal: There are approximately 270 permitted municipal discharges within the Houston 208 planning area. The storage/retrieval system for the municipal inventory operates in the same manner as the system designed for the industrial inventory. Differences are as follows:

The self-reporting data totals on the municipal inventory printout include flow, BOD and TSS. These totals are presented for all reporting treatment plants.

Since SIC number is not applicable to municipal treatment plants, the SIC number is not a recall item for the municipal storage/retrieval system. It should be noted that a listing of municipal dischargers based on a recall number will not include dischargers for whom that recall number was not provided.

## Summary

The storage/retrieval system involves the computerized storage of data and its retrieval by specified recall items. A large volume of data can be handled in this manner. Self-reporting data totals and introductory information are provided with each printout. Alphabetically ordered printouts by name of permittee for the industrial and municipal inventories are presented in computer printout form and are available at H-GAC.

# Discussion of Graphics

## Introduction

The locations of industrial and municipal wastewater discharges to surface waters have been plotted on 1 inch = 1 mile Base Maps. The method used to plot the discharges and the form of the location maps are discussed as follows:

## Industrial

Geographical coordinates of the discharge point, the route followed by the discharge, tax maps for the 208 area, and the plant address were referred to when plotting the discharge locations. The first step was to locate the discharge on the 1 inch = 1 mile base maps using geographical coordinates. The discharge route was used to help verify the accuracy of the geographical coordinates. In cases where (1) geographical coordinates were not available, (2) where plotting by coordinates implied a discharge route different from the recorded route, or (3) discharge route was not available, the plant address and local tax maps were referred to as aids in approximating the location of the outfall.

The plant address and local tax maps also proved especially valuable in cases where only partial coordinates (e.g., no seconds) were available, where the discharge route was generalized (e.g., "to Houston Ship Channel") and where several industries were located along a short length of watercourse.

**Map Form.** The exhibits prepared to display the industrial wastewater discharge points are a series of reproducible overlays to be used in conjunction with corresponding 1 inch = 1 mile base maps. Each permitted industrial wastewater outfall is located on an overlay by its respective WCO number. The digits of the WCO number preceding the dash identify the industrial plant. The numbers following the dash identify the specific outfall(s).

The point shown on the map represents the point at which the outfall discharges to a watercourse if such a location was ascertainable. When tax maps and the plant address were required to locate the discharge, the point shown on the map represents the location of the industrial plant.

## Municipal

**Method.** Geographical coordinates and discharge routes acted as the basis for plotting the municipal wastewater discharge locations. The geographical coordinates were used to locate the discharge on the 1 inch = 1 mile scale base maps. The discharge route was used to verify the accuracy of the geographical coordinates. In some cases either the geographical coordinates were not given or plotting them implied a discharge route different from the recorded route. In these cases, the plant location was plotted.

**Map Form.** The exhibits prepared to display the municipal wastewater discharge points are a series of reproducible overlays to be used in conjunction with the corresponding 1 inch = 1 mile base maps. Each permitted municipal wastewater outfall is located on an overlay by its respective WCO number. The digits of the WCO number preceding the dash identify the permit holder. The numbers after the dash identify the specific treatment plant.

## Summary of Current Industrial and Municipal Discharges

The industrial inventory is summarized in Table I-5. The municipal inventory is summarized in Table I-6. These tables summarize current industrial and municipal discharge totals for each subbasin, as reported in the inventories.

## TABLE I-1

## LOCATION OF CENSUS TRACTS BY COUNTY

## HOUSTON 208 AREA

| Census Tract Number | County |
|---|---|
| 0121 through 0126 | Harris |
| 0201 through 0275 | Harris |
| 0301 through 0375 | Harris |
| 0401 through 0559 | Harris |
| 0601, 0602, 0603 | Brazoria |
| 0701 through 0706 | Fort Bend |
| 0801, 0802, 0803 | Waller |
| 0901 through 0905 | Montgomery |
| 1201 through 1216 | Galveston |

# TABLE I-2

## TWQB STREAM SEGMENTS IN HOUSTON 208 AREA

**0900 Series:**

0901, 0902

**1000 Series:**

1001, 1002, 1003, 1004, 1005, 1006, 1007, 1008, 1009, 1010, 1011

**1100 Series:**

1101, 1102, 1103, 1104

**2000 Series:**

2421, 2425, 2426, 2427, 2428, 2429, 2430, 2436, 2438

## TABLE I-3

## SUB-BASIN KEY

| Subbasin | Description |
|---|---|
| 01 | Upstream section of Spring Creek watershed - Segment 1008 |
| 02 | Middle section of Spring Creek watershed - Segment 1008 |
| 03 | Downstream section of Spring Creek watershed - Segment 1008 |
| 04 | Upstream section of Cypress Creek watershed - Segment 1009 |
| 05 | Middle section of Cypress Creek watershed - Segment 1009 |
| 06 | Downstream section of Cypress Creek watershed - Segment 1009 |
| 07 | East and West Forks San Jacinto River, Caney Creek & Lake Houston - Segments 1002, 1010, 1003, and 1004 |
| 08 | Upstream section of Buffalo Bayou watershed - Segment 1007 |
| 09 | Upstream section of White Oak Bayou watershed - Segment 1007 |
| 10 | Downstream section of White Oak Bayou watershed - Segment 1007 |
| 11 | Upstream section of Greens Bayou watershed - Segment 1006 |
| 12 | Middle section of Greens Bayou watershed - Segment 1006 |
| 13 | Downstream section of Greens Bayou watershed - Segment 1006 |

TABLE I-3 (Continued)

| Subbasin | Description |
|---|---|
| 14 | Sheldon Reservoir area - Segment 1006 |
| 15 | Upstream section of Lower San Jacinto River - Segment 1001 |
| 16 | Downstream section of Lower San Jacinto River - Segment 1001 |
| 17 | Carpenter Bayou watershed - Segment 1006 |
| 18 | Upstream section of Cedar Bayou watershed - Segment 0902 |
| 19 | Downstream section of Cedar Bayou watershed - Segment 0901 |
| 20 | Goose Creek Watershed - Segment 1005 |
| 21 | West section of Buffalo Bayou watershed - Segment 1007 |
| 22 | West central section of Buffalo Bayou watershed - Segment 1007 |
| 23 | East central section of Buffalo Bayou watershed - Segment 1007 |
| 24 | East section of Buffalo Bayou watershed - Segment 1007 |
| 25 | Panther Creek/upper ship channel watershed - Segment 1006 |
| 26 | Upstream section of Hunting Bayou watershed - Segment 1006 |
| 27 | Downstream section of Hunting Bayou watershed - Segment 1006 |
| 28 | West section of Brays Bayou watershed - Segment 1006 |

TABLE I-3 (Continued)

| Subbasin | Description |
|---|---|
| 29 | West central section of Brays Bayou watershed - Segment 1006 |
| 30 | East central section of Brays Bayou watershed - Segment 1006 |
| 31 | East section of Brays Bayou watershed - Segment 1006 |
| 32 | Upstream section of Sims Bayou watershed - Segment 1006 |
| 33 | Central section of Sims Bayou watershed - Segment 1006 |
| 34 | Downstream section of Sims Bayou watershed - Segment 1006 |
| 35 | Vince Bayou watershed - Segment 1006 |
| 36 | Cotton Patch Bayou watershed plus several ditches on south side of HSC - Segment 1006 |
| 37 | Boggy Bayou watershed |
| 38 | Drainage ditches on north side of HSC - Segment 1006 |
| 39 | Patrick and Tucker Bayou watershed - Segment 1006 |
| 40 | Western Section of HSC watershed between mouth of the San Jacinto River and Morgan Point - includes San Jacinto Bay - Segments 1005 and 2427 |
| 41 | Eastern section of HSC watershed between mouth of the San Jacinto River and Morgan Point - includes Burnett, Scott, Black Duck and Tabbs Bays - Segments 1005, 2430, 2429 2428 and 2426 |

TABLE I-3 (Continued)

| Subbasin | Description |
|---|---|
| 42 | Upstream section of Clear Creek watershed - Segment 1101 |
| 43 | Downstream section of Clear Creek watershed - Segment 1101 |
| 44 | Clear Lake watershed - Segment 2425 |
| 45 | Direct drainage area of Galveston Bay including Barbours Cut and Bayport Channel - Segments 2421, 2436 and 2438 |
| 46 | Dickinson Bayou watershed - Segments 1103 and 1104 |

## TABLE I-4

## SIC GROUPS AND NUMBERS IN HOUSTON 208 AREA

**SIC 02**
0212

**SIC 13**
1321
1389

**SIC 15**
1521

**SIC 20**
2011
2013
2026
2033
2044
2048
2051
2052
2082
2086
2097
2099

**SIC 23**
2393

**SIC 24**
2491

**SIC 26**
2611
2621
2649
2653
2655

**SIC 27**
2711
2752

**SIC 28**
2812
2813
2819
2821
2822
2842
2843
2851
2861
2865
2869
2873
2874
2875
2879
2899

**SIC 29**
2911
2951
2952
2992

**SIC 30**
3069
3079

**SIC 32**
3221
3241
3273
3292

**SIC 33**
3312
3315
3317

**SIC 34**
3411
3433
3441
3469
3471
3479
3494

**SIC 35**
3532
3533
3546
3559
3561

**SIC 36**
3644
3662
3679

**SIC 38**
3824

**SIC 40**
4011
4013

**SIC 42**
4213
4221
4231

**SIC 44**
4463
4469

**SIC 47**
4784
4789

**SIC 49**
4911
4939
4953
4961

**SIC 50**
5084
5092
5093

**SIC 51**
5153

**SIC 65**
6512

**SIC 70**
7011

**SIC 72**
7213
7215
7218

**SIC 73**
7395
7399

**SIC 75**
7538

**SIC 76**
7629

**SIC 80**
8062

## TABLE I-5

## SUMMARY OF CURRENT INDUSTRIAL DISCHARGES BY SUBBASIN HOUSTON 208 AREA*

| Subbasin | Flow MGD | BOD Lb/Day | TSS Lb/Day | COD Lb/Day |
|---|---|---|---|---|
| 01 | 0.0 | 0.0 | 0.0 | 0.0 |
| 02 | 0.0 | 0.0 | 0.0 | 0.0 |
| 03 | 0.0 | 0.0 | 0.0 | 0.0 |
| 04 | 0.0 | 0.0 | 0.0 | 0.0 |
| 05 | 0.0 | 0.0 | 0.0 | 0.0 |
| 06 | 0.025 | 4.040 | 5.660 | --- |
| 07 | 0.0 | 0.0 | 0.0 | 0.0 |
| 08 | 0.0 | 0.0 | 0.0 | 0.0 |
| 09 | 0.809 | 17.560 | 512.560 | 216.440 |
| 10 | 0.830 | 34.380 | 627.400 | 199.280 |
| 11 | 2.124 | 50.900 | 1463.900 | --- |
| 12 | 0.034 | 4.570 | 7.690 | 9.850 |
| 13 | 29.438 | 1072.100 | 4483.250 | 7120.859 |
| 14 | 0.005 | 0.580 | 0.580 | 1.950 |
| 15 | 0.0 | 0.0 | 0.0 | 0.0 |
| 16 | 1.818 | 53.830 | 272.930 | 578.230 |
| 17 | 0.170 | 11.560 | 27.250 | 64.920 |
| 18 | 0.0 | 0.0 | 0.0 | 0.0 |
| 19 | 0.0 | 0.0 | 0.0 | 0.0 |
| 20 | 0.0 | 0.0 | 0.0 | 0.0 |

## TABLE I-5 (Continued)

| Subbasin | Flow MGD | BOD Lb/Day | TSS Lb/Day | COD Lb/Day |
|---|---|---|---|---|
| 21 | 0.160 | 5.150 | 32.030 | 65.150 |
| 22 | 0.694 | 11.090 | 37.000 | 297.310 |
| 23 | 0.0 | 0.0 | 0.0 | 0.0 |
| 24 | 1.069 | 49.480 | 178.040 | 344.830 |
| 25 | 0.172 | 23.590 | 33.630 | 170.000 |
| 26 | 0.925 | 102.480 | 181.440 | 907.220 |
| 27 | 0.162 | 24.840 | 24.820 | 79.240 |
| 28 | 0.445 | 9.580 | 57.930 | 116.730 |
| 29 | 0.034 | 0.350 | 30.270 | 3.480 |
| 30 | 0.070 | 1.610 | 4.720 | 13.500 |
| 31 | 1.700 | 112.940 | 257.250 | 833.800 |
| 32 | 0.359 | 12.610 | 38.660 | 0.000 |
| 33 | 0.112 | ---- | 13.240 | 18.780 |
| 34 | 10.116 | 3466.060 | 4024.360 | 24368.680 |
| 35 | 155.142 | 8955.390 | 26784.131 | 120139.102 |
| 36 | 33.616 | 1381.490 | 7318.670 | 8779.080 |
| 37 | 6.877 | 651.900 | 901.800 | 4609.530 |
| 38 | 15.911 | 4515.870 | 17904.500 | 65572.727 |
| 39 | 94.627 | 3224.740 | 63301.234 | 27071.137 |
| 40 | 465.125 | 1316.160 | 1813.130 | 7668.560 |

## TABLE I-5 (Continued)

| Subbasin | Flow MGD | BOD Lb/Day | TSS Lb/Day | COD Lb/Day |
|---|---|---|---|---|
| 41 | 36.756 | 2842.870 | 7367.521 | 27058.260 |
| 42 | 0.0 | 0.0 | 0.0 | 0.0 |
| 43 | 388.595 | 2099.740 | 15474.240 | 49515.332 |
| 44 | 0.0 | 0.0 | 0.0 | 0.0 |
| 45 | 1434.340 | --- | --- | --- |
| 46 | 0.086 | 7.370 | 11.050 | 138.010 |
| Total for Houston 208 area | 2682. | 31065. | 153191. | 345962. |

*The number of significant digits presented in this table does not imply accuracy to that level. The figures presented are simply the average of reported values during the period of study. The wide range of values portrayed would require omitting discharges in some subbasins if rounding were attempted. Therefore, the values have been listed as reported. Totals have been rounded to the nearest MGD or pound, as appropriate.

TABLE I-5 (Continued)

| Subbasin | Flow MGD | BOD Lb/Day | TSS Lb/Day | COD Lb/Day |
|---|---|---|---|---|
| 41 | 36.756 | 2842.870 | 7367.521 | 27058.260 |
| 42 | 0.0 | 0.0 | 0.0 | 0.0 |
| 43 | 388.595 | 2099.740 | 15474.240 | 49515.332 |
| 44 | 0.0 | 0.0 | 0.0 | 0.0 |
| 45 | 1434.340 | --- | --- | --- |
| 46 | 0.086 | 7.370 | 11.050 | 138.010 |
| Total for Houston 208 area | 2682. | 31065. | 153191. | 345962. |

*The number of significant digits presented in this table does not imply accuracy to that level. The figures presented are simply the average of reported values during the period of study. The wide range of values portrayed would require omitting discharges in some subbasins if rounding were attempted. Therefore, the values have been listed as reported. Totals have been rounded to the nearest MGD or pound, as appropriate.

## TABLE I-6

## SUMMARY OF CURRENT MUNICIPAL DISCHARGES BY SUBBASIN
## HOUSTON 208 AREA*

| Subbasin | Flow MGD | BOD Lb/Day | TSS Lb/Day |
|---|---|---|---|
| 01 | 0.0 | 0.0 | 0.0 |
| 02 | 0.227 | 4.00 | 19.11 |
| 03 | 0.980 | 43.42 | 78.23 |
| 04 | 0.0 | 0.0 | 0.0 |
| 05 | 1.386 | 58.27 | 182.62 |
| 06 | 1.981 | 102.67 | 214.87 |
| 07 | 0.672 | 14.58 | 71.79 |
| 08 | 2.189 | 287.17 | 1510.46 |
| 09 | 7.628 | 403.74 | 1091.66 |
| 10 | 0.0 | 0.0 | 0.0 |
| 11 | 4.657 | 612.50 | 859.84 |
| 12 | 4.123 | 144.36 | 3304.71 |
| 13 | 2.237 | 128.48 | 516.74 |
| 14 | 0.0 | 0.0 | 0.0 |
| 15 | 0.204 | 19.83 | 20.97 |
| 16 | 1.083 | 416.33 | 302.82 |
| 17 | 1.382 | 163.05 | 137.65 |
| 18 | 0.180 | 12.90 | 47.70 |
| 19 | 2.272 | 248.16 | 351.56 |
| 20 | 0.0 | 0.0 | 0.0 |

## TABLE I-6 (Continued)

| Subbasin | Flow MGD | BOD Lb/Day | TSS Lb/Day |
|---|---|---|---|
| 21 | 15.289 | 1026.17 | 2114.06 |
| 22 | 1.724 | 230.91 | 231.73 |
| 23 | 0.0 | 0.0 | 0.0 |
| 24 | 77.376 | 63460.379 | 168023.766 |
| 25 | 2.049 | 222.26 | 487.89 |
| 26 | 1.365 | 182.26 | 470.37 |
| 27 | 1.241 | 136.28 | 221.03 |
| 28 | 2.830 | 139.25 | 416.54 |
| 29 | 24.338 | 967.43 | 2069.61 |
| 30 | 1.390 | 212.70 | 300.68 |
| 31 | 0.0 | 0.0 | 0.0 |
| 32 | 5.456 | 787.64 | 1212.56 |
| 33 | 3.877 | 1587.47 | 2947.94 |
| 34 | 47.166 | 3536.61 | 6430.36 |
| 35 | 5.365 | 2014.91 | 1688.41 |
| 36 | 2.575 | 443.89 | 471.64 |
| 37 | 1.403 | 220.80 | 181.09 |
| 38 | 0.0 | 0.0 | 0.0 |
| 39 | 0.052 | 0.24 | 0.46 |
| 40 | 0.059 | 3.10 | 4.09 |

## TABLE I-6 (Continued)

| Subbasin | Flow MGD | BOD Lb/Day | TSS Lb/Day |
|---|---|---|---|
| 41 | 4.702 | 558.73 | 640.83 |
| 42 | 7.577 | 402.28 | 546.93 |
| 43 | 2.058 | 49.44 | 103.66 |
| 44 | 3.542 | 186.26 | 258.29 |
| 45 | 2.237 | 186.85 | 294.23 |
| 46 | 0.125 | 8.30 | 9.26 |
| Total for Houston 208 Area | 245. | 79224. | 197836. |

*The number of significant digits presented in this table does not imply accuracy to that level. The figures presented are simply the average of reported values during the period of study. The wide range of values portrayed would require omitting discharges in some subbasins if rounding were attempted. Therefore, the values have been listed as reported. Totals have been rounded to the nearest MGD or pound, as appropriate.

# CHAPTER II - EXISTING WATER USE PLANS AND DEMAND PROJECTIONS

## CHAPTER II - EXISTING WATER USE PLANS AND DEMAND PROJECTIONS

### Introduction

This chapter presents for the Greater Houston 208 area a model for projecting water demands and an assessment of existing water supply plans. The Water Demand Model projects water demands in the 208 area for the planning period 1975 to 1995 by agricultural, power generation, domestic, and industrial user categories. The assessment of existing water supply plans identifies and summarizes both the water supply plans affecting the 208 area and key policies that influence or regulate water supply planning.

The first section, Water Supply Policies and Plans, discusses Water Policy, Surface Water Rights, Groundwater Rights, and Water Supply Plans.

The second section discusses projected Water Demands. It consists of a detailed description of the Water Demand Model and will serve as a user guide to future use of that model.

The third section, summarizing this chapter, discusses existing and future water availability and total water demands for the Houston 208 area. Additional information provided in the appendices includes computer printouts of the model, input data, and demand projections by subbasin.

### Water Supply Policies and Plans

#### Introduction

The purpose of this section is to identify and summarize existing water supply plans that affect the delivery of water to the Houston 208 area. By indicating the status of area water supply plans, this assessment complements the projection of 208 area water demands.

Although the Houston 208 area is only slightly larger than Harris County, numerous agencies located within the 208 area or within the drainage areas of the principal segments supplying the 208 area, have a role in water supply planning. The diverse structure is composed primarily of organizations whose principal concern is supplying water and, secondarily, agencies which exert an influence on the policies of these organizations.

The information compiled on these organizations has been collected through a review of the literature and a survey of those organizations which have a role, either through policy development or actual planning, in providing water to customers in the Houston 208 area. The following parts of this section briefly outline the search for information, discuss water policies and plans pertinent to the 208 area, and present a summary of water availability.

## Water Policy

Regulatory policies pertaining to the supply of water to the Houston 208 area are those discussing surface water rights and groundwater rights. Surface water rights are administered through the state by the Texas Water Rights Commission and the Texas Water Development Board. Groundwater rights are administered for a large portion of the 208 area through the Harris-Galveston Coastal Subsidence District.

Surface Water Rights. Two basic doctrines of surface water rights are recognized in Texas, appropriative rights and riparian rights. The following discussion is taken in part from the Texas Water Plan. Riparian rights arise by operation of common law concepts as an incident to the ownership of land abutting a stream or watercourse. Appropriative rights, on the other hand, are regulated by statute. They are not necessarily related to land ownership and are acquired by compliance with statutory requirements implemented by the rules and regulations of the Texas Water Rights Commission.

In Texas today, anyone who desires to appropriate water must make an application in writing to the Texas Water Rights Commission. The Commission, as a regulatory agency with broad discretionary powers, is charged with the administration of rights to the surface water resources of the State. Once the right to the use of water has been perfected by (1) issuance of a permit from the Texas Water Rights Commission, and (2) subsequent beneficial use of the water by the permittee, the water authorized to be appropriated under the terms of the particular permit is not subject to further appropriation until the permit expires or is cancelled. Formal cancellation of unused permits is possible by administrative action initiated by the Commission or by judicial proceedings to adjudicate water rights between claimants.

In addition to the permitting function administered by the Texas Water Rights Commission, surface waters are investigated by the Surface Water Division of the Texas Water Development Board.

Groundwater Rights. Groundwater rights in the Houston 208 area are governed principally by the Harris-Galveston Coastal Subsidence District (HGCSD). HGCSD was formed by the 64th Texas Legislature in 1975 to provide for the regulation of the withdrawal of groundwater within Harris and Galveston Counties. Information for the following discussion was taken, in part, from the HGCSD District Plan, 1976.

The regulation of groundwater withdrawals in the Houston area is a necessary measure to control ground subsidence in Harris and Galveston Counties. The HGCSD recognizes that groundwater is a valuable natural resource and that the aquifers that provide this resource to Harris and Galveston Counties are capable of sustaining limited withdrawal. However, the maximum yields of the aquifers, in order to satisfy the criteria of stable pressures with no further subsidence, are not precisely known.

The HGCSD has examined the area within its jurisdiction for the purpose of taking action to minimize and end the amount of irreparable and irreversible damage that would take place if subsidence were allowed to continue. The HGCSD will exercise its regulatory authority to effect the necessary reduction in groundwater withdrawal. The HGCSD, in effecting the reduction in groundwater withdrawal, will make its decisions and will adopt such rules, regulations and orders which are reasonable and based on all pertinent factors, including the availability of surface water, the economic impact upon persons and the community, the degree of effect of subsidence upon the surface of the land, and the differing topographical and geophysical characteristics. Moreover, in order to effectively and expeditiously accomplish its goals the HGCSD has determined that specific regulatory efforts be directed to an "area of concentrated emphasis."

The area of concentrated emphasis, because of its lower elevation and proximity to Galveston Bay, is critically susceptible to tidal inundation and allows no acceptable margin for additional subsidence. While the primary emphasis for reducing groundwater withdrawal will be directed at the area of concentrated emphasis which covers a significant portion of the Houston 208 area, regulation outside this area will neither be overlooked nor postponed. Also, the HGCSD will consider the availability of surface water, the economic impact upon persons and the community, and the degree of effect of subsidence in regulating wells outside the area of concentrated emphasis.

In addition to the HGCSD activities, the Texas Water Development Board's Groundwater Division conducts extensive programs investigating groundwater in Texas. These programs include the filing of surveys of ground and surface waters uses for all counties in Texas.

## Water Supply Plans

Introduction. Numerous public agencies and organizations were contacted in order to assess the status of water supply planning for the Houston 208 area. Agencies and organizations that were contacted are listed on Table II-1.

Groups that contribute to planning for the supply of water for the 208 area are discussed in the following text. The planning activities of these groups are of a generally informal nature and provide the ability to respond to needs as required. These discussions include, where applicable and practical, the name of the agency or organization, the nature of their planning activities, the length of their planning period, the plan completion date, water sources, water usage by source, the drainage area, and other pertinent information.

### TABLE II-1

### AGENCIES AND ORGANIZATIONS CONTACTED

| | Name of Agency or Organization | Water Supply Planning Activities For Houston 208 Area |
|---|---|---|
| 1. | San Jacinto River Authority | Yes |
| 2. | Harris-Galveston Coastal Subsidence District | Yes |
| 3. | Texas Water Development Board | Yes |
| 4. | Houston Lighting & Power Company | Yes |
| 5. | Brazos River Authority | Yes |
| 6. | Coastal Industrial Water Authority, City of Houston and other area municipalities, Trinity River Authority | Yes |
| 7. | Galveston County Water Authority | Yes |
| 8. | Texas Water Rights Commission | Yes |
| 9. | Texas Department of Health Resources | No |
| 10. | Corps of Engineers | No |
| 11. | Harris County Health Department | No |
| 12. | City of Houston Health Department | No |
| 13. | City of Houston Water Department | No |
| 14. | Harris County Agricultural Extension Agent | No |
| 15. | Brazoria County Agricultural Extension Agent | No |
| 16. | Galveston County Agricultural Extension Agent | No |
| 17. | Waller County Agricultural Extension Agent | No |
| 18. | Fort Bend County Agricultural Extension Agent | No |
| 19. | Montgomery County Agricultural Extension Agent | No |
| 20. | Texas Agricultural Extension Service | No |
| 21. | Texas Water Resource Institute | No |

**1. San Jacinto River Authority (SJRA)** - The SJRA provides surface water to the Houston 208 area. SJRA contractual commitments extend to the year 1998, but no scheduled completion dates are identified. The source of supply for SJRA customers is the San Jacinto River indirectly and Lake Houston, Lake Conroe and SJRA canals directly. The drainage area of the San Jacinto River is approximately 3,967 square miles. Supplies available to the 208 area from the San Jacinto River total approximately 210 MGD.

The principal users of San Jacinto River surface waters are the City of Houston, petrochemical refineries and one electrical power generation plant. One notable exception is agricultural use in the Goose Creek watershed. The agricultural use is allowed on a temporary basis until the supply is committed to an anticipated municipal use.

**2. Harris-Galveston Coastal Subsidence District (HGCSD)**
The HGCSD maintains an on-going planning process aimed at controlling groundwater withdrawals at an acceptable but as yet undetermined rate. The water sources which are regulated by the HGCSD are the aquifers underlying Harris and Galveston Counties. These are principally the Chicot and Evangeline aquifers.

The HGCSD has estimated pumping for the calendar year 1977 slightly in excess of 500 MGD for its two-county area. The HGCSD intends to reduce this rate of withdrawal even further by limiting permits for groundwater withdrawals and encouraging the use of surface waters whenever feasible; however, pumping can occur at a level less than 490 MGD if points of withdrawal are properly located to avoid concentration of withdrawal zones. The 490 MGD quantity is based on the HGCSD Groundwater Hearing Report for 1976.

The HGCSD regulates groundwater withdrawals by permitting wells in the two counties. Permits are issued only upon application by a well owner or his representative and then only after review by HGCSD at a public hearing. In reviewing applications for permits, the HGCSD considers (a) the purposes of their enabling legislation; (b) the HGCSD District Plan; (c) the quality, quantity and availability of surface water at prices competitive with those charged by suppliers of surface water within the district; (d) the economic impact on the permit applicant from grant or denial of the permit, or the terms prescribed by the permit; and (e) the relative effect on subsidence. In carrying out its purpose, the district is empowered to require the reduction of groundwater withdrawals to amounts which will restore and maintain sufficient artesian pressure to control and prevent subsidence.

3. **Texas Water Development Board (TWDB)** - The TWDB has certain technical and planning functions for the state, including the preparation of a comprehensive state water plan (The Texas Water Plan) and the maintenance of technical programs related to water availability, water quality protection, water reclamation, and other water-related services.

The Planning Division continually evaluates water problems of the state, water supply needs, and water resource development potential. The Division formulates planning objectives, coordinates the board's studies and plans with those of local, state, and federal agencies, and evaluates out-of-state water resources that may become available to meet future water requirements in Texas.

The technical functions of the board related to groundwater are performed by the Ground Water Division. This includes administration and negotiation of cooperative programs of groundwater study with state, local and federal agencies; field investigation of groundwater resources; initiation of needed research programs with public and private groups; and provision of information necessary for delineation of underground water reservoirs by the Texas Water Rights Commission in response to local petition.

The Surface Water Division conducts surface water data-gathering programs and administers the topographic mapping program; conducts, updates, and refines hydrologic studies for water planning purposes; evaluates proposed alternatives of water development projects; assists in establishing criteria for operation of interbasin transfer systems and imported water; conducts and participates in bay and estuary studies, principally in order for the board to determine freshwater needs; evaluates effects of waste discharges and reservoir impoundment on surface water quality as these affect the Texas Water Plan; administers the Texas Weather Modification Act; conducts climatic studies to include consideration of droughts, floods, evaporation rates, and hurricanes; provides support for the Texas Defense and Disaster Relief Council and its Emergency Operations Center; assists in providing flood-plain information services; assists local entities in qualifying for flood insurance; and conducts special studies of surface-water salinity problems and salinity alleviation.

The TWDB is specifically charged with the duty of preparing, developing, and formulating a comprehensive state water plan, including a definition and designation of river basins and watersheds as separate units for purposes of water development and interwatershed transfers. The scope of the planning program encompasses all water resources available to Texas and includes consideration of possible importation from out-of-state sources. Matched against these sources, water requirements have been projected for municipalities, industry, agriculture, recreation, and all other users of water.

In November, 1968 the board released the Texas Water Plan which the Texas Water Rights Commission accepted, following a formal hearing, as giving "adequate consideration to the protection for existing water rights" and taking into account "modes and procedures for the equitable adjustment of water rights" affected by the plan. On this recommendation, the Water Development Board formally adopted the plan, and by its adoption the Texas Water Plan became by law "a flexible guide to state policy for the development of water resources in this state."

With reference to the Houston metropolitan area, the Texas Water Plan and a new planning document, Continuing Water Resources Planning and Development for Texas (Draft), issued by the TWDB in May, 1977 indicate long-term water supply deficits by the year 2020. The yields available from Lake Conroe and Lake Houston, and the proposed Cleveland, Lake Creek, and Lower East Fork Reservoirs in the San Jacinto River Basin; existing Lake Livingston and the proposed Wallisville Reservoir in the Trinity River Basin; proposed diversions from the lower Brazos River Basin; and the safe yield of groundwater aquifers in the area will provide additional future water supplies for the Houston area. These sources will not be sufficient, however, to supply the projected total requirements of the Houston metropolitan and industrial complex to the year 2020.

The choice of alternatives developed to meet future demands would be predicated in part on future decisions relating to the distribution system(s) within Harris County. However, long-range requirements of the area beyond the year 2020 indicate advantages to the area by obtaining at least a portion of its future supply from interstate transfer. Final decisions must necessarily involve more detailed studies by the Board in cooperation with local agencies involved.

The Texas Water Plan recognizes the need for interbasin transfer in order to supply Houston and surrounding areas with adequate water supplies. The plan proposes a canal system to run generally parallel to the Gulf Coast to facilitate proposed east to west diverions of surface waters.

4. Houston Lighting & Power Company (HL&P) - HL&P operates ten power generation plants which serve the Houston metropolitan area and its environs. Eight of these plants which exert a significant demand on water resources are located within the Greater Houston 208 area. Since water supplies are an important factor in the generation of electricity, and the demand for electricty is constantly rising, water supply planning by HL&P is essential.

Water demands from HL&P plants are supplied by various combinations of surface waters, groundwaters, and saline waters. In 1975, all of the plants in the 208 area were withdrawing considerable quantities of groundwater. Presently, HL&P is converting two of the power plants in the 208 area from groundwater to surface water. Future plans include similar conversions for an additional two plants. The water supplies for these plants are provided through contractual arrangements with the Harris-Galveston Coastal Subsidence District, the City of Houston, and several of the area river authorities.

5. Brazos River Authority (BRA) - The BRA currently supplies only negligible amounts of waters to the 208 area. However, the Brazos River, which drains over 44,640 square miles of Texas, is considered by the BRA and the Texas Water Plan as a major potential source of water for Houston's future demands.

In the vicinity of the Houston 208 area, water is diverted from the Brazos into a canal system and then delivered to agricultural, domestic, industrial, and power generator users. Water demand for agricultural uses is decreasing due to increased conversion of land from agricultural to municipal and industrial uses. As the quantities of water delivered to this area for agriculture decrease, the supply of water available for industrial and domestic use will increase. However, the long-range yields of the existing BRA reservoirs are essentially committed under existing contracts. Large-scale future diversions of Brazos water to the Houston 208 area may be supplied from Lakes Limestone, North Fork, Granger, Aquilla and Millican which are under construction or planned for construction in the future.

6. Coastal Industrial Water Authority (CIWA), City of Houston and other area municipalities, Trinity River Authority (TRA) - In the Houston 208 area, CIWA, Houston and other area municipalities, and the TRA are closely interrelated for water supply planning purposes. Recognizing that the Houston area water supply basis needed to change from an historically groundwater-oriented system to a combined system in which surface water sources furnish most of the supply, CIWA developed a conveyance and distribution system to supply the Houston area with water from the Trinity River.

Although the City of Houston has the rights to water transferred through CIWA, CIWA is the planning agency for this system. CIWA's planning period began in 1968 and runs to the year 2008. CIWA water is planned for power generation, industrial, municipal, and agricultural uses.

The Trinity River drains approximately 17,979 square miles and can supply the Houston 208 area with approximately 495 MGD. This is based on the estimated yield of Lake Livingston and is cited in correspondence of July 26, 1976 from the TRA. The CIWA conveyance system, however, is expected to yield 150 MGD by the end of 1977 and increase this incrementally up to 1500 MGD by the year 2008. Water delivered to the area in excess of the Trinity yields will possibly come as a result of interbasin transfers of east Texas waters.

Although much of the water currently used by the City of Houston and other area municipalities is groundwater, conversion to surface water as a source of supply for domestic demands is increasing. The City of Houston will become the supplier for an increasing number of smaller municipalities as the Harris-Galveston Coastal Subsidence District denies permits for groundwater withdrawals. In turn, the City of Houston, which is a major user of groundwater, will use increasing amounts of surface waters from the CIWA system and the Trinity River, the San Jacinto River and its canal systems, and possibly from the Brazos River.

7. Galveston County Water Authority (GCWA) - The GCWA was created in 1965 by a special act of the Legislature of Texas. The planning area boundaries of the GCWA are contiguous with the boundaries of Galveston County. The purpose of the authority is to provide an adequate supply of water for the inhabitants and water users of Galveston County.

The principal sources of water are the San Jacinto and Brazos Rivers, relatively small amounts of groundwater (40 MGD) and, potentially, the Trinity River. The present source of water for domestic users is treated water from the San Jacinto River delivered to the Galveston County line by the City of Houston. Industrial, agricultural, and power generator users are supplied by water from the Brazos River. Trinity River water is not being supplied to Galveston County at this time.

8. Texas Water Rights Commission (TWRC) - With regard to the Houston 208 area, the TWRC serves as a regulatory agency which monitors authorized and claimed surface water rights and reported surface water usage. The following description of the TWRC function is taken from a Guide to Texas State Agencies prepared by the Bureau of Government Research of the University of Texas.

The Texas Water Rights Commission is the successor to the former Texas Water Commission and the State Board of Water Engineers. Its primary objective, as stated by statute, is "to conserve this natural resource in the greatest practicable measure for the public welfare." In carrying out this mandate, the Commission performs a number of functions, including the administration of water rights, the collection of data, the supervision of certain water districts, and other regulatory activities.

Under the Water Agency Reorganization Act passed in 1965, the Water Rights Commission was given duties relating primarily to protection of the public interest and private rights in water use and development. The Commission receives, administers, and acts on all applications for permits made by persons, political subdivisions, or the Texas Water Development Board to appropriate public waters for beneficial use or storage or to construct works for the impoundment, storage, diversion, or transportation of public waters. In addition, the Commission administers proceedings for the cancellation and forfeiture, in whole or in part, of permits and certified filings for the appropriations of public waters.

The Texas Water Rights Commission was given the responsibility of holding public hearings on the comprehensive, statewide water plan to be prepared by the Texas Water Development Board, and of determining whether the plan includes adequate consideration of water rights.

The Water Rights Division assists the Commission in the regulation of water rights. It maintains programs in ownership, adjudication, and cancellation. The ownership program involves continuous up-dating of ownership records on land having statutory rights (certified filings and permits) so that annual water use report forms and public notices can be mailed to owners of record. The adjudication program handles records of claims under the Water Rights Adjudication Act.

Public policy of the state forbids ownership of public water without continuous beneficial use. Permits and certified filings not used for 10 consecutive years are subject to forfeiture, after notice of hearings. The division's cancellation program maintains the continuing review of unused water rights and develops the engineering data and evidence for specific cancellation rights.

# Projected Water Demands

## Introduction

The Water Demand Model (WADEMO) projects water demands by four user sectors for the planning period 1975 to 1995. The water demand projection methodology is discussed in four subparts corresponding to the four user sectors in the Water Demands section below.

WADEMO and the several data bases necessary for its functioning have been put on a computer format. The inherent flexibility of the computer format permits the consideration of alternative control assumptions at later dates.

Abbreviations and symbols used in the equations are:

S/W' ratio: The ratio of wastewater volumes to water supply
S: Wastewater (Sewage) volume
W': Water demand for a given SIC industry group
N: Total industrial water demand
j: Subbasin identification number
t: Projection year identification number
i: Standard Industrial Classification number
R: S/W' ratio for a given SIC industry group
W: Wastewater volume
A: Agricultural water demands
L: Number of acres
c: Crop identification numbers
I: Water use coefficient for a crop
T: Total number of acres in a county which are within the 208 area
L: Total number of acres in a county
G: Total irrigation water demand in a county
H: The number of irrigated acres in a county
h: Data collection period identification number for TWDB data on agricultural water use
g: County identification number
E: Power generation water demand
X: Current (1975) water use for power generation by generator plant
y: Power generator plant identification number
P: Population as number of persons
D: Domestic water demand
U: Per capita water demand factor

## Water Demands

Water demands are modeled for the Greater Houston 208 Area for the planning period 1975 to 1995. Water demands are projected by subbasin and by user category (industrial, domestic, agricultural, power generation) for the years 1975, 1977, 1983, 1985, 1990 and 1995. All demands are expressed in millions of gallons per day (MGD).

The water demand model is composed of four sets of equations corresponding to the four user categories. The procedure and its conceptual bases are outlined below in the following order:

1. Industrial
2. Agricultural
3. Power Generation
4. Domestic

Industrial. Industrial water demands are projected by applying sewage to water supply (S/W') ratios to projected industrial effluents. The S/W' ratio is the quotient of wastewater discharges (S) divided by total water use (W'). Industries modeled are limited to those identified in the Industrial Wasteload Projection Model of the Point Source Analysis Activity.

Total industrial water demands (N) are identified by subbasin (j) and year (t) by summing the quotients of the wastewater volume (W) of a given Standard Industrial Classification (SIC) industry (i) present in a subbasin divided by that SIC's S/W ratio (R). The following equation illustrates this procedure:

$$(N)_{jt} = \sum_{i} \frac{(W)_{ijt}}{(R)_{i}}$$

Output from this procedure identifies total projected industrial water demand by subbasin and by year.

S/W' ratios for this model are taken from the following three references:

Malina, Joseph F., and Burleson, Ned K., Criteria for Estimating Municipal and Industrial S/W Ratios and Wastewater Quality Profiles, (Austin: University of Texas, 1972)

Clark, J. W., et al., Water Supply and Pollution Control 2nd Ed., (Scranton, Pa.: International Textbook Company, 1971)

National Association of Manufacturers, Water in Industry, (New York: N.A.M., 1965)

Agricultural. These water demands in the Houston 208 area are principally related to the irrigation of croplands. Rice farming is the primary demand of irrigation water.

Agricultural water demand projections for the Houston 208 area are based on acres of irrigated agricultural land and per-acre irrigation requirements. Total agricultural water demands (A) are identified by subbasin (j) and are held constant through the planning period. By holding irrigation demand constant, several assumptions are made. First, total agricultural area in the 208 area will decrease due to intensified competition for space near metropolitan Houston. Second, although total agricultural area will decrease, the total area of irrigated crop lands will remain relatively fixed due to the significant capital investments made for water conveyance to the irrigated fields.

The number of acres (L) of cropland (c) in subbasin (j) are multiplied by an annual water use coefficient (I) to derive the average agricultural water demand, $(A)_{jt}$. The following equation illustrates this procedure:

$$(A)_{jt} = (L)_{cjt}\ (I)$$

The acres of cropland, $(L)_{cjt}$, have been estimated for the year 1985 (i.e., t = 1985). For Harris County this determination was made in the following steps:

1. Averaging agricultural land by census tract over 1975 - 1995 and summing averages,
2. Dividing the value of irrigated acres by total agricultural acres from "1" above,
3. Multiplying quotient in "2" above by each tract average, thereby obtaining each census tract's calculated number of irrigated agricultural acres for 1985 based on the 1974 inventory,

4. By representing fifty acres of irrigated land with a dot symbol, the distribution of the irrigated land was presented on census tract maps of the 208 area, and

5. Following the plotting of the data on tract maps, a subbasin overlay provided boundaries within which the dot symbols were counted to obtain agricultural land use by subbasin.

For portions of counties other than Harris County that fall within the 208 area, a different procedure was required since agricultural land was combined with vacant land and classified as undeveloped land. The following steps were required:

1. Divide total county irrigated acres by total county acres.

2. Multiply this quotient by the total census tract acres of census tracts that are within the 208 area. This product is held to be the number of acres of irrigated cropland in the census tract.

3. These values are mapped in the same fashion as for Harris County.

References for these data are:

Houston-Galveston Area Council, Population and Land Use, (Houston: HGAC, 1976)

Texas Water Development Board, Inventories of Irrigation in Texas 1958, 1964, 1969, and 1974, R196 (Austin: TWDB, 1975)

The value for the annual per acre water use coefficient (I) is derived from data from the TWDB Report 196. Derivation of this coefficient is by dividing the acres of a county that are within the 208 area (T) by the total number of acres in the county (L) and multiplying this quotient by the county's total annual irrigation water requirement (G) and dividing this value by the sum of T/L times the number of irrigated acres (H). These values summed by four historical time periods (h) representing the TWDB R196 inventory and summed for all counties (g) are then averaged by multiplying by 0.25. This value, which is the weighted average per acre irrigation requirement for the 208 area, is a constant in the demand model. The following equation symbolizes this derivation.

$$I = \sum_{h=1}^{4} \sum_{g=1}^{6} \frac{(T)(G)/(L)_{gh}}{(T)(H)/(L)_{gh}} \qquad (0.25)$$

Power Generation. These water demands in the entire 208 area are exerted by Houston Lighting and Power Company. HL&P operates eight power plants that are located in the 208 area. Power generation water demand is projected by multiplying the current water use levels by the ratio of future population to current population.

Power generation water demand (E) is identified by subbasin (j) and year (t). Current water use levels (X) by plant (y) have been obtained from the Houston Lighting and Power Company. Future population data is from H-GAC, Population and Land Use, (Houston: HGAC, 1976). Population data in the equation below are identified as (P):

$$E_{jt} = (X)_y \frac{(P)_{t+1}}{(P)_t}$$

Domestic. These water demands are projected by multiplying subbasin populations times an estimated per capita water demand factor. Domestic water demand (D) which includes all municipal demands is identified by subbasin (j) and year (t) by multiplying the per capita demand factor (U) with the populations of subbasins. The following equation illustrates this procedure:

$$D_{jt} = (U)(P)_{jt}$$

The per capita demand factor (U) is based on historical data from Houston and is cited in the following publication:

Trinity River Authority, Supplemental Data and Evaluation, Wallisville Reservoir Project, Texas, (TRA: 1976)

The per capita demand value is 150 gallons per capita per day for municipal water use for the Houston 208 area.

## Summary and Conclusions

Water demands were projected according to the methodology presented earlier and are depicted for the Houston 208 area on the table at the end of this chapter. These figures indicate a continually rising demand for water for the Houston 208 area throughout the planning period.

Considering existing water supplies outlined in the plans, it can be expected that water demands will exceed supplies in the future. Existing water supplies available to the Houton 208 area include: 210 MGD from the San Jacinto River under dry weather low flows, 495 MGD from the Trinity River under dry weather low flows, and 490 MGD from groundwater sources under safe yield constraints designed to abate subsidence. However, in considering supplies and demands which appear to be imbalanced, three factors mitigate apparent water deficits. (1) The cited available supplies are artificially constrained and, in fact, more water is available under critical conditions from area aquifers than is indicated. (2) The effects of the Federal Water Pollution Control Act Amendments of 1975 (PL-92-500) which can be expected to reduce industrial water consumption are not yet clearly quantified and are not reflected in this study. (3) Additional water supplies may be developed with interbasin transfer of waters to complement the ultimate conveyance capacity of CIWA of 1500 MGD. This would be in addition to the yields from the San Jacinto River and area aquifers.

Attempts were made to identify the source of supply expected to meet the specific water demands. Efforts were directed toward allocating demands to groundwater or surface water supplies and toward ordering these allocations by user category and by subbasin. Because of the lack of available data on the users of groundwater and because of the mixing of ground and surface waters in distribution systems, these efforts were modified to the presentation of the probable source of supply as found on the table at the end of this chapter. The percentages of the probable source of supply in this table are based on the known surface water use in 1975 and the safe yield of area aquifers for subsequent years.

More detailed studies of water allocations by small areas such as the subbasins will become feasible when comprehensive data bases are developed. The Harris-Galveston Coastal Subsidence District (HGCSD) is presently compiling data on the location of wells and the quantities of water being pumped from these wells. In May, 1977 spokesmen for the HGCSD indicated that approximately 60-70% of all wells in Harris and Galveston counties have been identified and that these wells probably account for 90-95% of all groundwater withdrawals.

## TABLE II-2

## WATER DEMANDS AND ALLOCATIONS SUMMARY
## HOUSTON 208 PLANNING AREA

### DEMAND IN MGD AND PERCENT OF TOTAL ANNUAL DEMANDS

| | YEAR | 1975 | 1977 | 1983 | 1985 | 1990 | 1995 |
|---|---|---|---|---|---|---|---|
| DEMAND SECTOR | Industrial[1] | 484(52) | 662(58) | 890(62) | 967(64) | 1202(67) | 1489(70) |
| | Agricultural[2] | 102(11) | 102(9) | 102(7) | 102(7) | 102(6) | 102(4) |
| | Power Generation[3] | 12(1) | 12(1) | 14(1) | 15(1) | 17(1) | 18(1) |
| | Domestic[4] | 340(36) | 360(32) | 419(30) | 437(28) | 480(26) | 533(25) |
| | Total | 938(100) | 1136(100) | 1425(100) | 1521(100) | 1801(100) | 2142(100) |

### PROBABLE SOURCE OF SUPPLY IN PERCENT OF TOTAL DEMAND

| | YEAR | 1975 | 1977 | 1983 | 1985 | 1990 | 1995 |
|---|---|---|---|---|---|---|---|
| SOURCE OF SUPPLY | Groundwater[5] | 80 | 43 | 35 | 32 | 27 | 23 |
| | Surface Water[6] | 20 | 57 | 65 | 68 | 73 | 77 |

1. Industrial demands are based on reported and projected wastewater flows adjusted by S/W ratios.
2. Agricultural demands are based on 1974 inventories of irrigation for Texas.
3. Power generation demands are based on 1975 HL&P water use surveys adjusted by population projections.
4. Domestic demands are based on per capita usage rates and population data and projections.
5. Groundwater allocations are based on estimated demand in 1975 and on estimated aquifer recharge rate for the period 1977-1995 equivalent to current permitted withdrawals.
6. Surface water allocations are based on reported use for 1975 and estimated demands for the period 1977-1995.
7. Demands by Subbasin and user category are available in computer printout form at the H-GAC.

# CHAPTER III - PROBLEM AREA IDENTIFICATION

# CHAPTER III - PROBLEM AREA IDENTIFICATION

## Introduction

It is the purpose of this chapter to review the inventory and projections of wastewater dischargers and the water quality data base to determine potential water quality problem areas. For these purposes, water quality problem areas are defined as those stream segments which may not meet segment water quality standards as established by the Texas Water Quality Board (TWQB). Industrial Wasteload Projections of Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) discharges were developed and the methodology is presented in Appendix A to this chapter. Projections of municipal discharges of BOD and TSS were obtained by H-GAC working with the City of Houston and the methodology is presented in Appendix B to this chapter. Water quality standards and recent stream water quality data were obtained from TWQB or as otherwise indicated on the appropriate table. When available, TWQB wasteload evaluations for stream segments were consulted and provided a basis for determining acceptable wasteloads.

Water quality standards and data have been reviewed by stream segment to correspond with the available records and stream standards. Subbasins contributing wastewater flows to each stream segment have been identified to aid in subsequent analyses. When appropriate, tables summarize the existing water quality, projected wasteloads, and recorded violations.

## Problem Area Review

### Segment 0901

Stream Segment 0901 is the tidal portion of Cedar Bayou, located in the northeastern portion of the planning area. The water uses established by TWQB for this segment are contact recreation, non-contact recreation, and propagation of fish and wildlife. The following standards have been set for this segment:

| | |
|---|---|
| Dissolved Oxygen, mg/l | |
| (not less than) | 4.0 |
| pH | 6,5 to 8.5 |
| Fecal Coliform (not more than) | 200 MPN/100 ml |
| Temperature | 95°F. |

This segment receives drainage and discharges from subbasin 19. Current (1975) total municipal discharges for this subbasin are 278 lbs./day BOD and 296 lbs./day TSS with a total wastewater discharge rate of 2.2 MGD. There are no industrial discharges into this segment. Most recent water quality samples for the segment indicate that standards for Fecal Coliform and D.O. are not being met.and this segment has been designated as a water quality problem area.

Projected changes in municipal discharges show increases in flow to 3.0 MGD and TSS to 381 lb/day with a decrease in BOD to 254 lb/day. Table III-1 presents existing and projected wastewater discharges to this segment.

## TABLE III-1

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

***SEGMENT 0901**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | -- | 2.2 | 2.2 |
| $BOD_5$ (lb./day) | -- | 278 | 278 |
| TSS (lb./day) | -- | 296 | 296 |
| **1983** | | | |
| Flow (MGD) | -- | 2.5 | 2.5 |
| $BOD_5$ (lb./day) | -- | 213 | 213 |
| TSS (lb./day) | -- | 319 | 319 |
| **1990** | | | |
| Flow (MGD) | -- | 2.8 | 2.8 |
| $BOD_5$ (lb./day) | -- | 237 | 237 |
| TSS (lb./day) | -- | 355 | 355 |
| **1995** | | | |
| Flow (MGD) | -- | 3.0 | 3.0 |
| $BOD_5$ (lb./day) | -- | 254 | 254 |
| TSS (lb/day) | -- | 381 | 381 |

**Number of Recorded Violations****

| | |
|---|---|
| D.O. (mg/l) | 1 |
| pH | -- |
| Fecal Coliform (MPN/100 ml) | 2 |
| Temp. (°F.) | -- |
| Chloride (mg/l) | -- |
| Sulfate (mg/l) | -- |
| TDS (mg/l) | -- |

* Indicates continuing water quality problem area.

** From Water Quality Management Plan for the San Jacinto Basin, Texas Water Quality Board, Draft Report, 1976.

**Segment 0902**

Stream segment 0902 is the non-tidal portion of Cedar Bayou, located in the northeastern portion of the planning area. The water uses established by TWQB for this segment are non-contact recreation, propagation of fish and wildlife, and domestic water supply. The following standards have been set for this segment:

| | |
|---|---|
| D.O. | 5.0 mg/1 |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 1,000 MPN/100 ml |
| Temperature | 90°F. |
| Chlorides | 200 mg/1 |
| Sulfates | 100 mg/1 |
| TDS | 400 mg/1 |

This stream segment receives drainage and discharges from subbasin 18. Current (1975) total industrial and municipal discharges for this subbasin are 14 lbs./day BOD and 39 lbs./day TSS with a total wastewater discharge rate of 0.2 MGD. Most recent water quality samples for the segment indicate that standards for Fecal Coliform are being met except following rainstorms when agricultural runoff is likely to have a significant effect. Dissolved Oxygen levels are generally being met. Projected waste discharges from both municipal and industrial sources are expected to total 43 lbs./day BOD and 65 lbs./day TSS by 1995 and do not appear to be great enough to deleteriously affect water quality in this segment. Therefore, this segment has not been designated a water quality problem area. Table III-2 presents existing and projected wastewater discharges to this segment.

## TABLE III-2

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

**SEGMENT 0902**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | -- | 0.2 | 0.2 |
| $BOD_5$ (lb./day) | -- | 14 | 14 |
| TSS (lb./day) | -- | 39 | 39 |
| **1983** | | | |
| Flow (MGD) | -- | 0.3 | 0.3 |
| $BOD_5$ (lb./day) | -- | 28 | 28 |
| TSS (lb./day) | -- | 42 | 42 |
| **1990** | | | |
| Flow (MGD) | -- | 0.5 | 0.5 |
| $BOD_5$ (lb./day) | -- | 38 | 38 |
| TSS (lb./day) | -- | 57 | 57 |
| **1995** | | | |
| Flow (MGD) | -- | 0.5 | 0.5 |
| $BOD_5$ (lb./day) | -- | 43 | 43 |
| TSS (lb./day) | -- | 65 | 65 |

**Number of Recorded Violations***

| | |
|---|---|
| D.O. (mg/l) | 1 |
| pH | -- |
| Fecal Coliform (MPN/100 ml) | 4 |
| Temp. (°F.) | -- |
| Chloride (mg/l) | -- |
| Sulfate (mg/l) | -- |
| TDS (mg/l) | -- |

* From Water Quality Management Plan for the San Jacinto Basin, Texas Water Quality Board, Draft Report, 1976.

## Segment 1001

Stream segment 1001 is the tidal portion of the San Jacinto River. The water uses established by TWQB for this segment are contact recreation, non-contact recreation, and propagation of fish and wildlife. The following standards have been set for this segment:

| | |
|---|---|
| D.O. | 4.0 mg/l |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 200 MPN/100 ml |
| Temperature | 95°F. |

TWQB has calculated a Wasteload Evaluation target oxygen demand (assimilative capacity) of 6,953 lbs./day for this segment. This was prepared as a part of the Wasteload Evaluation, approved 26 November 1974.

Subbasins 15 and 16 drain to this segment. Current (1975) total industrial and municipal discharges for these subbasins are 546 lbs./day BOD and 643 lbs./day TSS with a wastewater discharge rate of 2.8 MGD. Projected (1995) municipal and industrial discharges total 585 lbs./day BOD, 822 lbs./day TSS, which is less than the calculated assimilative capacity. However, the San Jacinto River Basin Plan indicates that low Dissolved Oxygen levels have occurred in the past. The plan attributed those low Dissolved Oxygen levels to wastes from the Houston Ship Channel which diffuse into Segment 1001. The lower portion of the segment is the only portion where problems were recorded in that plan. Reveiw of the most recent data available for this segment does not indicate that a D.O. problem currently exists, and projected discharges to the segment do not indicate that a problem will develop. Therefore, this segment has not been designated as a water quality problem area. Table III-3 presents existing and projected wastewater discharges to this segment.

## TABLE III-3

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

**SEGMENT 1001**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | 1.8 | 1.0 | 2.8 |
| BOD$_5$ (lb./day) | 234 | 312 | 546 |
| TSS (lb./day) | 273 | 370 | 643 |
| **1983** | | | |
| Flow (MGD) | 6.7 | 1.4 | 8.1 |
| BOD$_5$ (lb./day) | 338 | 117 | 454 |
| TSS (lb./day) | 458 | 175 | 633 |
| **1990** | | | |
| Flow (MGD) | 7.5 | 1.7 | 8.3 |
| BOD$_5$ (lb./day) | 379 | 144 | 523 |
| TSS (lb./day) | 510 | 217 | 727 |
| **1995** | | | |
| Flow (MGD) | 8.3 | 2.0 | 10.3 |
| BOD$_5$ (lb./day) | 420 | 165 | 585 |
| TSS (lb./day) | 575 | 247 | 822 |

**Number of Recorded Violations***

| | |
|---|---|
| D.O. (mg/1) | -- |
| pH | 2 |
| Fecal Coliform (MPN/100 ml) | 2 |
| Temp. (°F.) | -- |
| Chloride (mg/1) | -- |
| Sulfate (mg/1) | -- |
| TDS (mg/1) | -- |

* From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976,

## Segment 1002

Stream segment 1002 is Lake Houston, and is predominantly rural although residential development in the area is increasing. The water uses established for this segment by TWQB are contact recreation, non-contact recreation, propagation of fish and wildlife, and domestic water supply. The following standards have been set for this segment:

| | |
|---|---|
| D.O. | 5.0 mg/l |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 200 MPN/100 ml |
| Temperature | 90°F. |
| Chloride | 100 mg/l |
| Sulfate | 50 mg/l |
| TDS | 200 mg/l |

TWQB has prepared a wasteload evaluation (issued 27 May 1975) for the segment. This evaluation resulted in recommendations to classify the segment as a water quality limited segment, careful scrutiny of any proposed discharges, and an investigation of the nutrient status of the lake. The segment receives drainage and discharges from subbasin 07. Current (1975) total industrial and municipal discharges to this segment are 16 lbs./day BOD and 59 lbs./day TSS with a wastewater discharge rate of 0.5 MGD. Recent water quality data indicate that Dissolved Oxygen levels are above the established standard. Although there were sporadic violations of other standards, there have been none during the most recent year and one half. This indicates that previous problems have been alleviated. Projected total waste discharges in 1995 are 131 lbs./day BOD and 197 lbs./day TSS. These discharges should not pose a significant problem. However, the wasteload evaluation conducted by TWQB indicated that future proposed discharges should be closely scrutinized. Table III-4 presents existing and projected wastewater discharges to this segment.

## TABLE III-4

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

### SEGMENT 1002

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | — | 0.5 | 0.5 |
| $BOD_5$ (lb./day) | — | 16 | 16 |
| TSS (lb./day) | — | 59 | 59 |
| **1983** | | | |
| Flow (MGD) | — | 0.9 | 0.9 |
| $BOD_5$ (lb./day) | — | 76 | 76 |
| TSS (lb./day) | — | 114 | 114 |
| **1990** | | | |
| Flow (MGD) | — | 1.2 | 1.2 |
| $BOD_5$ (lb./day) | — | 103 | 103 |
| TSS (lb./day) | — | 155 | 155 |
| **1995** | | | |
| Flow (MGD) | — | 1.6 | 1.6 |
| $BOD_5$ (lb./day) | — | 131 | 131 |
| TSS (lb./day) | — | 197 | 197 |

**Number of Recorded Violations***

| | |
|---|---|
| D.O. (mg/l) | — |
| pH | — |
| Fecal Coliform (MPN/100 ml) | 3 |
| Temp. (°F.) | 1 |
| Chloride (mg/l) | 2 |
| Sulfate (mg/l) | 2 |
| TDS (mg/l) | — |

* From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 1003

Stream segment 1003 is the East Fork of the San Jacinto River above Lake Houston. The water uses established by TWQB for this segment are non-contact recreation, propagation of fish and wildlife, and domestic water supply. The following standards have been set for this segment:

| | |
|---|---|
| D.O. | 5.0 mg/l |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 2,000 MPN/100 ml |
| Temperature | 91°F. |
| Chlorides | 80 mg/l |
| Sulfate | 40 mg/l |
| TDS | 400 mg/l |

TWQB prepared a wasteload evaluation (approved 25 June 1974) for this segment which indicated a calculated target load (assimilative capacity) of approximately 8000 lbs./day BOD. This calculation was reviewed in light of probable benthal demands from the swampy areas in the upper watershed, and it has been estimated that a target wasteload for BOD should be near zero. The segment receives drainage and discharges from subbasin 07. Although there are currently no municipal nor industrial discharges to this segment within the study area, recent water quality data indicate that standard values for Fecal Coliform and pH are occasionally exceeded. Violations of pH standards may be attributable to natural runoff rather than industrial or municipal discharges. High Fecal Coliform rates cannot be classified as a violation since sampling frequency does not meet the requirements for definition as set forth by TWQB.

Since there are no current discharges to the segment within the study area and since no discharges are projected, future violations will be attributable to natural or upstream causes, and the segment is not designated as a problem area. Table III-5 presents existing and projected wastewater discharges to this segment.

## TABLE III-5

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

**SEGMENT 1003**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | -- | -- | -- |
| $BOD_5$ (lb./day) | -- | -- | -- |
| TSS (lb./day) | -- | -- | -- |
| **1983** | | | |
| Flow (MGD) | -- | -- | -- |
| $BOD_5$ (lb./day) | -- | -- | -- |
| TSS (lb./day) | -- | -- | -- |
| **1990** | | | |
| Flow (MGD) | -- | -- | -- |
| $BOD_5$ (lb./day) | -- | -- | -- |
| TSS (lb./day) | -- | -- | -- |
| **1995** | | | |
| Flow (MGD) | -- | -- | -- |
| $BOD_5$ (lb./day) | -- | -- | -- |
| TSS (lb./day) | -- | -- | -- |

**Number of Recorded Violations***

| | |
|---|---|
| D.O. (mg/1) | 1 |
| pH | 2 |
| Fecal Coliform (MPN/100 ml) | 2 |
| Temp. (°F.) | -- |
| Chloride (mg/1) | 2 |
| Sulfate (mg/1) | 1 |
| TDS (mg/1) | -- |

* From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 1004

Stream segment 1004 is the West Fork of the San Jacinto River, between Lake Houston and the Lake Conroe dam. The water uses TWQB has established for this segment are contact recreation, non-contact recreation, propagation of fish and wildlife, and domestic water supply. The following standards have been set for this segment:

| | |
|---|---|
| D.O. | 5.0 mg/l |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 200 MPN/100 ml |
| Temperature | 95°F. |
| Chloride | 80 mg/l |
| Sulfate | 40 mg/l |
| TDS | 300 mg/l |

This stream segment receives drainage and discharges from subbasin 07. Recent water quality data indicate that violations of the Fecal Coliform standard may occur, although there are no current (1975) municipal or industrial discharges to this segment within the study area. However, since the sampling frequency for Fecal Coliform does not meet the requirements for definition set forth in TWQB requirements, a violation cannot be determined. The problem is significant enough to suspect that a violation does exist. Other individual values for Chloride, Sulfate, Dissolved Oxygen, and pH have been cited but do not appear to be a problem.

Since there are no dischargers to the segment within the planning area, contributors to the Fecal Coliform problem appear to lie outside the boundaries of the planning area, and it is expected that the problem will continue unless corrective measures are taken. Coordination with the San Jacinto River Authority, the planning agency for the non-designated portions of the San Jacinto River Basin, will be necessary to correct the Fecal Coliform problem. This segment is designated a potential problem area. Table III-6 presents existing and projected wastewater discharges to this segment.

## TABLE III-6

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

***Segment 1004**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | -- | 0.0 | 0.0 |
| $BOD_5$ (lb./day) | -- | 0.0 | 0.0 |
| TSS (lb./day) | -- | 0.0 | 0.0 |
| **1983** | | | |
| Flow (MGD) | -- | 0.0 | 0.0 |
| $BOD_5$ (lb./day) | -- | 3 | 3 |
| TSS (lb./day) | -- | 4 | 4 |
| **1990** | | | |
| Flow (MGD) | -- | 0.1 | 0.1 |
| $BOD_5$ (lb./day) | -- | 5 | 5 |
| TSS (lb./day) | -- | 8 | 8 |
| **1995** | | | |
| Flow (MGD) | -- | 0.1 | 0.1 |
| $BOD_5$ (lb./day) | -- | 8 | 8 |
| TSS (lb./day) | -- | 13 | 13 |

**Number of Recorded Violations****

| | |
|---|---|
| D.O. (mg/l) | 1 |
| pH | 1 |
| Fecal Coliform (MPN/100 ml) | 8 |
| Temp. (°F.) | -- |
| Chloride (mg/l) | 1 |
| Sulfate (mg/l) | 1 |
| TDS (mg/l) | -- |

* Indicates continuing water quality problem area.

** From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 1005

Stream segment 1005 is that portion of the Houston Ship Channel from Morgan's Point to its confluence with the San Jacinto River, including the tidal portion of the San Jacinto River to 200 yards below the Interstate Highway 10 bridge. The water uses TWQB has established for this segment are non-contact recreation and the propagation of fish and wildlife. The following standards have been set for this segment:

| | |
|---|---|
| D.O. | 4.0 mg/1 |
| pH | 6.0 to 8.5 |
| Fecal Coliform | 1,000 MPN/100 ml |
| Temperature | 95°F. |

TWQB has performed a wasteload evaluation (approved 25 September 1974) for all segments of the Houston Ship Channel. This evaluation revealed a need for greatly reduced discharges throughout the Houston Ship Channel area to meet the established standards. The segment receives drainage and discharges from subbasins 20, 40, and 41. Current (1975) total industrial and municipal discharges to this segment are 2800 lbs./day BOD and 7629 lbs./day TSS with a total wastewater discharge rate of 37.3 MGD. Texas Water Quality Board data reveals that Dissolved Oxygen levels have failed to meet standards on two occasions during 1976. This may be a result of discharges to the segment or a result of discharges to upstream segments such as 1006. Although a problem, continued limitations of discharges should be required in the future and improvement of upstream segments will be necessary. Projected 1995 waste discharges of 2392 lbs./day BOD and 8858 lbs./day TSS vary only slightly from present discharge levels, and therefore this segment is designated as a potential water quality problem area. Table III-7 presents existing and projected wastewater discharges to this segment.

## TABLE III-7

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

***SEGMENT 1005**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | 37.2 | 0.1 | 37.3 |
| $BOD_5$ (lb./day) | 2,797 | 3 | 2,800 |
| TSS (lb./day) | 7,625 | 4 | 7,629 |
| **1983** | | | |
| Flow (MGD) | 65.5 | 0.3 | 65.7 |
| $BOD_5$ (lb./day) | 1,484 | 23 | 1,507 |
| TSS (lb./day) | 5,219 | 35 | 5,254 |
| **1990** | | | |
| Flow (MGD) | 89.9 | 0.5 | 90.4 |
| $BOD_5$ (lb./day) | 1,989 | 39 | 2,028 |
| TSS (lb./day) | 9,076 | 59 | 9,135 |
| **1995** | | | |
| Flow (MGD) | 109.1 | 0.6 | 109.7 |
| $BOD_5$ (lb./day) | 2,341 | 51 | 2,392 |
| TSS (lb./day) | 8,782 | 76 | 8,858 |

**Number of Recorded Violations****

| | |
|---|---|
| D.O. (mg/l) | 2 |
| pH | 2 |
| Fecal Coliform (MPN/100 ml) | 8 |
| Temp. (°F.) | -- |
| Chloride (mg/l) | -- |
| Sulfate (mg/l) | -- |
| TDS (mg/l) | -- |

* Indicates continuing water quality problem area.

** From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 1006

Segment 1006 is the Houston Ship Channel from its confluence with the San Jacinto River to the Turning Basin and includes tidal portions of the tributaries. TWQB has not established water uses for the segment but it is known to be used for purposes of navigation. The following standards have been set for the segment:

| | |
|---|---|
| D.O. | 2.0 mg/1 |
| pH | 6.0 to 8.5 |
| Fecal Coliform | 2,000 MPN/100 ml |
| Temperature | 95°F. |

TWQB has performed a wasteload evaluation (approved 25 September 1974) for the Houston Ship Channel, which includes this segment. This evaluation revealed a need for greatly reduced discharges throughout the Houston Ship Channel area in order to meet the established Dissolved Oxygen standards. This particular segment receives drainage discharges from subbasins 11, 12, 13, 14, 17, 25, 26, 27, 28, 29, 30, 31 32, 33, 34, 35, 37, 38, and 39. It is a heavily industrialized segment and contains the majority of all industrial discharges in the planning area. Current (1975) total industrial and municipal discharges to this segment are 32,841 lbs./day BOD and 138,238 lbs./day TSS with a total wastewater discharge rate of 343.7 MGD. Projected 1995 wasteloads for this segment total 33,750 lbs./day BOD and 69,445 lbs./day TSS. Texas Water Quality Board data reveals that this segment has problems in meeting the Dissolved Oxygen standards and appears to have problems meeting the standards for Fecal Coliform. A violation of the Fecal Coliform standard cannot be determined since the frequency requirements of the TWQB standard have not been met. Consummation of plans to improve City of Houston municipal wastewater treatment facilities discharging to the segment will likely serve to alleviate the Fecal Coliform problem, but continued high discharges of BOD are expected. This segment will continue to be a problem area due to the level of activity which surrounds it. Table III-8 presents existing and projected wastewater discharges to this segment.

## TABLE III-8

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

***SEGMENT 1006**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | 233.7 | 110.0 | 343.7 |
| $BOD_5$ (lb./day) | 22,333 | 10,508 | 32,841 |
| TSS (lb./day) | 121,090 | 17,148 | 138,238 |
| **1983** | | | |
| Flow (MGD) | 413.7 | 141.5 | 555.3 |
| $BOD_5$ (lb./day) | 12,632 | 11,824 | 24,456 |
| TSS (lb./day) | 31,673 | 17,557 | 51,230 |
| **1990** | | | |
| Flow (MGD) | 519.7 | 169.7 | 689.5 |
| $BOD_5$ (lb./day) | 15,682 | 14,158 | 29,840 |
| TSS (lb./day) | 40,076 | 21,048 | 61,124 |
| **1995** | | | |
| Flow (MGD) | 603.5 | 187.2 | 790.7 |
| $BOD_5$ (lb./day) | 18,139 | 15,610 | 33,750 |
| TSS (lb./day) | 46,246 | 23,199 | 69,445 |

| Number of Recorded Violations** | |
|---|---|
| D.O. (mg/l) | 104 |
| pH | -- |
| Fecal Coliform (MPN/100 ml) | 76 |
| Temp. (°F.) | -- |
| Chloride (mg/l) | -- |
| Sulfate (mg/l) | -- |
| TDS (mg/l) | -- |

* Indicates continuing water quality problem area.

** From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 1007

Segment 1007 is the turning basin portion of the Houston Ship Channel. There are no specific water uses established for this segment which is consistent with its prime use as a ship channel. The following standards have been set for this segment:

| | |
|---|---|
| D.O. | 1.5 mg/1 |
| pH | 6.0 to 8.5 |
| Fecal Coliform | 2,000 MPN/100 ml |
| Temperature | 95°F. |

TWQB has performed a wasteload evaluation (approved 25 September 1974) for the Houston Ship Channel, which includes this segment. This evaluation revealed a need for greatly reduced discharges throughout the Houston Ship Channel area in order to meet the established dissolved oxygen standards.

This segment receives drainage and discharges form subbasins 08, 09, 10, 21, 22, 23, and 24. While it has a large number of industrial and municipal discharges, its primary contributors are municipal systems. Current (1975) total industrial and municipal discharges to this segment are 66,376 lbs./day BOD and 174,190 lbs./day TSS with a wastewater discharge rate of 108 MGD. Projected 1995 wasteloads for this segment total 11,576 lbs./day BOD and 16,453 lbs./day TSS, a substantial reduction. Texas Water Quality Board data reveals that this segment does not meet TWQB segment standards for Dissolved Oxygen, and probably does not meet the standards for Fecal Coliform. A violation of the Fecal Coliform standard cannot be determined, however, since the sampling frequency requirements of the TWQB standard have not been met. Even with the expected decrease in municipal waste discharges, this segment will continue to be a problem, due to the level of activity which surrounds it. Table III-9 presents existing and projected wastewater discharges to this segment.

## TABLE III-9

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

***SEGMENT 1007**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | 1.8 | 105.7 | 107.5 |
| BOD$_5$ (lb./day) | 189 | 66,187 | 66,376 |
| TSS (lb./day) | 613 | 173,576 | 174,190 |
| **1983** | | | |
| Flow (MGD) | 3.1 | 117.7 | 120.7 |
| BOD$_5$ (lb./day) | 215 | 9,814 | 10,029 |
| TSS (lb./day) | 446.2 | 13,965 | 14,411 |
| **1990** | | | |
| Flow (MGD) | 3.9 | 128.1 | 132.1 |
| BOD$_5$ (lb./day) | 266 | 10,688 | 10,953 |
| TSS (lb./day) | 510 | 15,130 | 15,640 |
| **1995** | | | |
| Flow (MGD) | 4.6 | 135.2 | 139.9 |
| BOD$_5$ (lb./day) | 299 | 11,278 | 11,576 |
| TSS (lb./day) | 543 | 15,911 | 16,453 |

| Number of Recorded Violations** | |
|---|---|
| D.O. (mg/l) | 24 |
| pH | -- |
| Fecal Coliform (MPN/100 ml) | 28 |
| Temp. ($^{o}$F.) | -- |
| Chloride (mg/l) | -- |
| Sulfate (mg/l) | -- |
| TDS (mg/l) | -- |

* Indicates continuing water quality problem area.

** From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

**Segment 1008**

Segment 1008 is Spring Creek. The water uses TWQB has established for the segment are non-contact recreation, propagation of fish and wildlife, and domestic water supply. The following standards have been set for this segment:

| | |
|---|---|
| D.O. | 5.0 mg/1 |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 2,000 MPN/100 ml |
| Temperature | 90°F. |
| Chloride | 80 mg/1 |
| Sulfate | 40 mg/1 |
| TDS | 300 mg/1 |

TWQB has performed a wasteload evaluation (approved 24 July 1974) of this segment. The evaluation shows a minimum calculated assimilative capacity of 9,900 lbs./day of oxygen demand. TWQB data shows reported values for Chloride and Dissolved Oxygen that do not meet the standards, and there are individual high values for Fecal Coliforms. The segment receives drainage and discharges from subbasins 01, 02, and 03. Total current (1975) municipal and industrial discharges for these subbasins are 116 lbs./day BOD and 210 lbs./day TSS with a total wastewater discharge rate of 1.9 MGD. Projected 1995 wasteloads for the segment total 425 lbs./day BOD and 638 lbs./day TSS. The data review indicated that problems existed, (i.e. the standards were frequently exceeded during 1973 and during 1974, and 1975), However, only one violation (Chloride) was noted during 1976. Since the wasteload evaluation indicated an assimilative capacity well in excess of that which is discharged to the segment, this segment is not now considered to be a problem area. Table III-10 presents existing and projected wastewater discharges to this segment.

## TABLE III-10

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

### SEGMENT 1008

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | -- | 1.9 | 1.9 |
| BOD$_5$ (lb./day) | -- | 116 | 116 |
| TSS (lb./day) | -- | 210 | 210 |
| **1983** | | | |
| Flow (MGD) | -- | 3.2 | 3.2 |
| BOD$_5$ (lb./day) | -- | 268 | 268 |
| TSS (lb./day) | -- | 402 | 402 |
| **1990** | | | |
| Flow (MGD) | -- | 4.3 | 4.3 |
| BOD$_5$ (lb./day) | -- | 360 | 360 |
| TSS (lb./day) | -- | 540 | 540 |
| **1995** | | | |
| Flow (MGD) | -- | 5.1 | 5.1 |
| BOD$_5$ (lb./day) | -- | 425 | 425 |
| TSS (lb./day) | -- | 638 | 638 |

### Number of Recorded Violations*

| | |
|---|---|
| D.O. (mg/l) | 1 |
| pH | 2 |
| Fecal Coliform (MPN/100 ml) | 5 |
| Temp. (°F.) | -- |
| Chloride (mg/l) | 2 |
| Sulfate (mg/l) | -- |
| TDS (mg/l) | -- |

* From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 1009

Segment 1009 is Cypress Creek. The water uses TWQB has established for this segment are non-contact recreation, propagation of fish and wildlife, and domestic water supply. The following standards have been set for the segment:

| | |
|---|---|
| D.O. | 5.0 mg/1 |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 2,000 MPN/100 ml |
| Temperature | 90°F. |
| Chloride | 80 mg/1 |
| Sulfate | 40 mg/1 |
| TDS | 400 mg/1 |

TWQB has performed a wasteload evaluation (revised 28 January 1975) for the segment. This evaluation resulted in recommendations for treatment levels greater than secondary treatment.

The segment receives drainage and discharges from subbasins 04, 05, and 06. Current (1975) total industrial and municipal discharges from these subbasins are 247 lbs./day BOD and 502 lbs./day TSS with a wastewater discharge rate of 3.685 MGD. Projected 1995 wasteloads total 623 lbs./day BOD and 934 lbs./day TSS. Texas Water Quality Board data reveals that individual samples of Sulfate, Chlorides, Fecal Coliform, or Dissolved Oxygen which do not meet the standards occur frequently in the segment. The projected growth in wasteloads discharged to the segment suggests that this segment will be a problem area in the future. Table III-11 presents existing and projected wastewater discharges to this segment.

## TABLE III-11

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

### *SEGMENT 1009

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | 0.0 | 3.7 | 3.7 |
| BOD$_5$ (lb./day) | 4.0 | 243 | 247 |
| TSS (lb./day) | 6 | 496 | 502 |
| **1983** | | | |
| Flow (MGD) | 0.0 | 5.3 | 5.3 |
| BOD$_5$ (lb./day) | 2 | 343 | 345 |
| TSS (lb./day) | 2 | 666 | 668 |
| **1990** | | | |
| Flow (MGD) | 0.0 | 6.7 | 6.7 |
| BOD$_5$ (lb./day) | 2 | 555 | 557 |
| TSS (lb./day) | 2 | 832 | 834 |
| **1995** | | | |
| Flow (MGD) | 0.0 | 7.4 | 7.5 |
| BOD$_5$ (lb./day) | 2 | 621 | 623 |
| TSS (lb./day) | 2 | 932 | 934 |

**Number of Recorded Violations****

| | |
|---|---|
| D.O. (mg/1) | 2 |
| pH | 1 |
| Fecal Coliform (MPN/100 ml) | 10 |
| Temp. ($^{o}$F.) | -- |
| Chloride (mg/1) | 9 |
| Sulfate (mg/1) | 2 |
| TDS (mg/1) | 14 |

* Indicates continuing water quality problem area.

** From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 1010

Segment 1010 is Caney Creek. The water uses TWQB has established for this segment are non-contact recreation, propagation of fish and wildlife, and domestic raw water supply. The standards which have been set are listed below:

| | |
|---|---|
| D.O. | 5.0 mg/1 |
| pH | 6.0 to 8.5 |
| Fecal Coliform | 2,000 MPN/100 ml |
| Temperature | 90°F. |
| Chloride | 80 mg/1 |
| Sulfate | 40 mg/1 |
| TDS | 400 mg/1 |

This segment lies partially within the planning area and receives drainage and discharge from subbasin 07. Current (1975) total industrial and municipal discharges from this subbasin are 1 lb/day BOD and 5 lbs./day TSS with a wastewater discharge rate of 0.02 MGD. Projected 1995 wasteloads show no discharges to this subbasin. Previous studies have shown limited problems. However, it is felt that these are caused by sources upstream of the project area, since only two discharges are in that portion of this segment that lies within the planning area and discharges within the study area are expected to cease by 1995. Therefore, this segment is not designated a problem area. Table III-12 presents existing and projected wastewater discharges to this segment.

## TABLE III-12

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

**SEGMENT 1010**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | -- | 0.02 | 0.02 |
| $BOD_5$ (lb./day) | -- | 1 | 1 |
| TSS (lb./day) | -- | 5 | 5 |
| **1983** | | | |
| Flow (MGD) | -- | 0.02 | 0.02 |
| $BOD_5$ (lb./day) | -- | 2 | 2 |
| TSS (lb./day) | -- | 2 | 2 |
| **1990** | | | |
| Flow (MGD) | -- | 0.02 | 0.02 |
| $BOD_5$ (lb./day) | -- | 2 | 2 |
| TSS (lb./day) | -- | 2 | 2 |
| **1995** | | | |
| Flow (MGD) | -- | -- | -- |
| $BOD_5$ (lb./day) | -- | -- | -- |
| TSS (lb./day) | -- | -- | -- |

**Number of Recorded Violations***

| | |
|---|---|
| D.O. (mg/1) | 1 |
| pH | -- |
| Fecal Coliform (MPN/100 ml) | 1 |
| Temp. (°F.) | -- |
| Chloride (mg/1) | -- |
| Sulfate (mg/1) | -- |
| TDS (mg/1) | -- |

* From Water Quality Management Plan for the San Jacinto Basin, Texas Water Quality Board, Draft Report, 1976.

## Segment 1011

Segment 1011 is Peach Creek. The water uses TWQB has established for this segment are non-contact recreation, propagation of fish and wildlife, and domestic water supply. The standards which have been set for this segment are listed below:

| | |
|---|---|
| D.O. | 5.0 mg/1 |
| pH | 6.0 to 8.5 |
| Fecal Coliform | 2,000 MPN/100 ml |
| Temperature | 90°F. |
| Chloride | 80 mg/1 |
| Sulfate | 40 mg/1 |
| TDS | 400 mg/1 |

Only a small portion of this segment lies within the study area. This portion receives drainage and discharges from subbasin 07. Previous studies have shown this segment to be in good condition, and, since there are currently no dischargers to this segment nor are there any projected, it has not been designated a problem area.

## Segment 1101

Segment 1101 is the tidal portion of Clear Creek. The water uses TWQB has established for this segment are non-contact recreation and propagation of fish and wildlife. The standards set are listed below:

| | |
|---|---|
| D.O. | 4.0 mg/1 |
| pH | 6.5 to 9.0 |
| Fecal Coliform | 2,000 MPN/100 ml |
| Temperature | 95°F. |

TWQB performed a wasteload evaluation (approved 25 June 1974) for this segment in conjunction with Clear Lake, and a portion of the upstream segment, 1102. The discharge target load, based on the assimilative capacity of the stream, was found to be 2,997 lbs./day of $BOD_5$.

The segment receives drainage and discharges from subbasin 43. Current (1975) total industrial and municipal discharges from this subbasin are 78 lbs./day BOD and 158 lbs./day TSS with a wastewater flow rate of 2.9 MGD. These discharges imply that currently the segment can assimilate all BOD discharges. TWQB data indicates that previous problems of high Fecal Coliform and low Dissolved Oxygen have been corrected. Only one sample (Fecal

Coliform) has exceeded the established standards since February, 1974. All other violations occurred prior to that time. Projected 1995 wasteloads total 289 lbs./day BOD and 434 lbs./day TSS. The projected growth of wasteloads discharged within subbasin 43 and the upstream segment 1102 do not presently appear to pose a threat to water quality in the segment based on the reported assimilative capacity. Therefore, the segment has not been designated a water quality problem area. Table III-13 presents existing and projected wastewater discharges to this segment.

## TABLE III-13

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

**SEGMENT 1101**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | 0.4 | 2.5 | 2.9 |
| $BOD_5$ (lb./day) | 14 | 64 | 78 |
| TSS (lb./day) | 20 | 138 | 158 |
| **1983** | | | |
| Flow (MGD) | 0.46 | 2.77 | 3.23 |
| $BOD_5$ (lb./day) | 14 | 231 | 245 |
| TSS (lb./day) | 20 | 346 | 366 |
| **1990** | | | |
| Flow (MGD) | 0.6 | 3.0 | 3.6 |
| $BOD_5$ (lb./day) | 17 | 252 | 269 |
| TSS (lb./day) | 26.0 | 378 | 404 |
| **1995** | | | |
| Flow (MGD) | 0.7 | 3.2 | 3.9 |
| $BOD_5$ (lb./day) | 22 | 267 | 289 |
| TSS (lb./day) | 34 | 400 | 434 |

**Number of Recorded Violations***

| | |
|---|---|
| D.O. (mg/l) | 5 |
| pH | -- |
| Fecal Coliform (MPN/100 ml) | 4 |
| Temp. (°F.) | -- |
| Chloride (mg/l) | -- |
| Sulfate (mg/l) | -- |
| TDS (mg/l) | -- |

* From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 1102

Segment 1102 is the non-tidal portion of Clear Creek. The water uses TWQB has established for this segment are non-contact recreation and the propagation of fish and wildlife. Water quality standards which have been set for this segment are listed below:

| | |
|---|---|
| D.O. | 5.0 mg/1 |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 2,000 MPN/100 ml |
| Temperature | 95°F. |
| Chloride | 200 mg/1 |
| Sulfate | 100 mg/1 |
| TDS | 600 mg/1 |

TWQB performed a wasteload evaluation for a portion of this segment in conjunction with Clear Lake and Segment 1101. The discharge target load, based on the assimilative capacity of the stream was found to be 2,997 lbs./day BOD.

The stream segment receives discharges and drainage from subbasin 42. Current (1975) total industrial and municipal discharges for this subbasin are 373 lbs./day BOD and 527 lbs./day TSS with a wastewater discharge rate of 6.7 MGD. Projected 1995 discharges total 910 lbs./day BOD and 1364 lbs./day TSS. Review of TWQB water quality data for this segment indicates that individual values for Fecal Coliform, Dissolved Oxygen and Chlorides exceed the standard values frequently enough to verify that the standards are being violated. The apparent violations and the projected growth of wasteload discharges are sufficient to designate the segment as a problem area. Table III-14 presents existing and projected wastewater discharges to this segment.

## TABLE III-14

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

***SEGMENT 1102**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | -- | 6.7 | 6.7 |
| $BOD_5$ (lb./day) | -- | 373 | 373 |
| TSS (lb./day) | -- | 527 | 527 |
| **1983** | | | |
| Flow (MGD) | -- | 8.4 | 8.4 |
| $BOD_5$ (lb./day) | -- | 701 | 701 |
| TSS (lb./day) | -- | 1,052 | 1,052 |
| **1990** | | | |
| Flow (MGD) | -- | 9.9 | 9.9 |
| $BOD_5$ (lb./day) | -- | 823 | 823 |
| TSS (lb./day) | -- | 1,234 | 1,234 |
| **1995** | | | |
| Flow (MGD) | -- | 10.9 | 10.9 |
| $BOD_5$ (lb./day) | -- | 910 | 910 |
| TSS (lb./day) | -- | 1,364 | 1,364 |

**Number of Recorded Violations****

| | |
|---|---|
| D.O. (mg/l) | 8 |
| pH | -- |
| Fecal Coliform (MPN/100 ml) | 4 |
| Temp. ($^{o}$F.) | -- |
| Chloride (mg/l) | 2 |
| Sulfate (mg/l) | 2 |
| TDS (mg/l) | 2 |

* Indicates continuing water quality problem area.

** From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 1103

Segment 1103 is the tidal portion of Dickinson Bayou. The water uses which TWQB has established for this segment are contact recreation, non-contact recreation, and the propagation of fish and wildlife. The following are the water quality standards established for this segment:

| | |
|---|---|
| D.O. | 4.0 mg/l |
| pH | 6.5 to 9.0 |
| Fecal Coliform | 200 MPN/100 ml |
| Temperature | 95°F. |

This stream segment receives a portion of the drainage and discharge of subbasin 46. Current (1975) total industrial and municipal discharges for subbasin 46 are 70 lbs./day BOD and 363 lbs./day TSS with a wastewater discharge rate of 2.8 MGD. Projected 1995 wasteloads total 287 lbs./day BOD and 430 lbs./day TSS. Review of TWQB water quality data for the segment indicates that past problems of low Dissolved Oxygen content have now been corrected but that high counts of Fecal Coliform continue to be a problem.

Due to high levels of Fecal Coliform and the projected increases in waste discharges, this segment is designated as a problem area. Table III-15 presents existing and projected wastewater discharges to this segment.

## TABLE III-15

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

### *SEGMENT 1103

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | 0.1 | 2.7 | 2.8 |
| $BOD_5$ (lb./day) | 7 | 63 | 70 |
| TSS (lb./day) | 11 | 352 | 363 |
| **1983** | | | |
| Flow (MGD) | 0.1 | 3.0 | 3.1 |
| $BOD_5$ (lb./day) | 6 | 248 | 254 |
| TSS (lb./day) | 8 | 371 | 379 |
| **1990** | | | |
| Flow (MGD) | 0.1 | 3.2 | 3.3 |
| $BOD_5$ (lb./day) | 8 | 265 | 273 |
| TSS (lb./day) | 10 | 398 | 408 |
| **1995** | | | |
| Flow (MGD) | 0.2 | 3.3 | 3.5 |
| $BOD_5$ (lb./day) | 9 | 278 | 287 |
| TSS (lb./day) | 13 | 417 | 430 |

### Number of Recorded Violations**

| | |
|---|---|
| D.O. (mg/1) | 4 |
| pH | -- |
| Fecal Coliform (MPN/100 ml) | 8 |
| Temp. (°F.) | -- |
| Chloride (mg/1) | -- |
| Sulfate (mg/1) | -- |
| TDS (mg/1) | -- |

* Indicates continuing water quality problem area.

** From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 1104

Segment 1104 is the non-tidal portion of Dickinson Bayou. The water uses TWQB has established for this segment are non-contact recreation and the propagation of fish and wildlife. The following water quality standards have been set for the segment:

| | |
|---|---|
| D.O. | 5.0 mg/1 |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 2,000 MPN/100 ml |
| Temperature | 90°F. |
| Chloride | 200 mg/1 |
| Sulfate | 100 mg/1 |
| TDS | 600 mg/1 |

The stream segment receives a portion of the drainage and discharges of subbasin 46. Current (1975) total industrial and municipal discharges for Segment 1104 are 14 lbs./day BOD and 19 lbs./day TSS with a wastewater discharge rate of 0.2 MGD. Projected 1995 wasteloads total 18 lbs./day BOD and 28 lbs./day TSS. Review of TWQB water quality data indicates that the segment has water quality problems regarding Dissolved Oxygen, Fecal Coliform, Chlorides, Sulfates, and Total Dissolved Solids. Due to these present apparent problems this segment has been designated a problem area. Table III-16 presents existing and projected wastewater discharges to this segment.

## TABLE III-16

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

***SEGMENT 1104**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | -- | 0.2 | 0.2 |
| $BOD_5$ (lb./day) | -- | 14 | 14 |
| TSS (lb./day) | -- | 19 | 19 |
| **1983** | | | |
| Flow (MGD) | -- | 0.2 | 0.2 |
| $BOD_5$ (lb./day) | -- | 17 | 17 |
| TSS (lb./day) | -- | 26 | 26 |
| **1990** | | | |
| Flow (MGD) | -- | 0.2 | 0.2 |
| $BOD_5$ (lb./day) | -- | 16 | 16 |
| TSS (lb./day) | -- | 24 | 24 |
| **1995** | | | |
| Flow (MGD) | -- | 0.2 | 0.2 |
| $BOD_5$ (lb./day) | -- | 18 | 18 |
| TSS (lb./day) | -- | 28 | 28 |

**Number of Recorded Violations****

| | |
|---|---|
| D.O. (mg/l) | 9 |
| pH | -- |
| Fecal Coliform (MPN/100 ml) | 3 |
| Temp. (°F.) | -- |
| Chloride (mg/l) | 3 |
| Sulfate (mg/l) | 3 |
| TDS (mg/l) | 3 |

* Indicates continuing water quality problem area.

** From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

**Segment 2421**

Segment 2421 is Galveston Bay. The water uses TWQB has established for this segment are contact recreation, non-contact recreation, and the propagation of fish and wildlife. The following standards have been set for this segment:

| | |
|---|---|
| D.O. | 4.0 mg/1 |
| pH | 6.5 to 9.0 |
| Fecal Coliform | 70 MPN/100 ml |
| Temperature | 95°F. |

This segment receives a portion of the drainage and discharge of subbasin 45. Total current (1975) municipal and industrial discharges in this segment are 212 lbs./day BOD and 391 lbs./day TSS with a wastewater discharge rate of 2.4 MGD. Projected 1995 wasteloads total 198 lbs./day BOD and 291 lbs./day TSS, a reduction from current levels. Incidences of high Fecal Coliform values, have been recorded in the San Jacinto River Basin plan prepared in 1975. This condition in the subbasin is cited as the reason for designating the segment as a problem area. Table III-17 presents existing and projected wastewater discharges to this segment.

## TABLE III-17

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

### *SEGMENT 2421

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | 0.2 | 2.2 | 2.4 |
| $BOD_5$ (lb./day) | 20 | 192 | 212 |
| TSS (lb./day) | 42 | 239 | 391 |
| **1983** | | | |
| Flow (MGD) | 0.3 | 2.2 | 2.5 |
| $BOD_5$ (lb./day) | 13 | 179 | 292 |
| TSS (lb./day) | 15 | 268 | 283 |
| **1990** | | | |
| Flow (MGD) | 0.4 | 2.1 | 2.5 |
| $BOD_5$ (lb./day) | 18 | 177 | 195 |
| TSS (lb./day) | 22 | 265 | 287 |
| **1995** | | | |
| Flow (MGD) | 0.5 | 2.1 | 2.6 |
| $BOD_5$ (lb./day) | 23 | 175 | 198 |
| TSS (lb./day) | 28 | 263 | 291 |

### Number of Recorded Violations**

| | |
|---|---|
| D.O. (mg/l) | -- |
| pH | -- |
| Fecal Coliform (MPN/100 ml) | 2 |
| Temp. (°F.) | -- |
| Chloride (mg/l) | -- |
| Sulfate (mg/l) | -- |
| TDS (mg/l) | -- |

* Indicates continuing water quality problem area.

** From Water Quality Management Plan for the San Jacinto Basin, Texas Water Quality Board, Draft Report, 1976.

## Segment 2425

Segment 2425 is known as Clear Lake. The water uses TWQB has established for this segment are contact recreation, non-contact recreation, and propagation of fish and wildlife. The following water quality standards have been set for this segment:

| | |
|---|---|
| D.O. | 4.0 mg/1 |
| pH | 6.5 to 9.0 |
| Fecal Coliform | 200 MPN/100 ml |
| Temperature | 95°F. |

This segment receives the drainage and discharge from subbasin 44. Total current (1975) industrial and municipal discharges in subbasin 44 are 262 lbs./day BOD and 382 lbs./day TSS with a wastewater discharge rate of 3.6 MGD. Projected 1995 wasteloads total 302 lbs./day BOD and 643 lbs./day TSS. Review of TWQB water quality data for the segment indicates that a Dissolved Oxygen problem, apparent in 1973, has been corrected and no problems currently exist. For this reason, this segment has not been designated as a water quality problem area. Table III-18 presents existing and projected wastewater discharges to this segment.

## TABLE III-18

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

### SEGMENT 2425

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | -- | 3.6 | 3.6 |
| $BOD_5$ (lb./day) | -- | 262 | 262 |
| TSS (lb./day) | -- | 382 | 382 |
| **1983** | | | |
| Flow (MGD) | -- | 4.6 | 4.6 |
| $BOD_5$ (lb./day) | -- | 237 | 237 |
| TSS (lb./day) | -- | 490 | 490 |
| **1990** | | | |
| Flow (MGD) | -- | 5.5 | 5.5 |
| $BOD_5$ (lb./day) | -- | 275 | 275 |
| TSS (lb./day) | -- | 579 | 579 |
| **1995** | | | |
| Flow (MGD) | -- | 6.2 | 6.2 |
| $BOD_5$ (lb./day) | -- | 302 | 302 |
| TSS (lb./day) | -- | 643 | 643 |

### Number of Recorded Violations*

| | |
|---|---|
| D.O. (mg/l) | 2 |
| pH | -- |
| Fecal Coliform (MPN/100 ml) | -- |
| Temp. ($^{o}$F.) | -- |
| Chloride (mg/l) | -- |
| Sulfate (mg/l) | -- |
| TDS (mg/l) | -- |

* From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 2426

Segment 2426 is known as Tabbs Bay. The water uses TWQB has established for the segment are contact recreation, non-contact recreation, and propagation of fish and wildlife. The following water quality standards have been set for this segment:

| | |
|---|---|
| D.O. | 4.0 mg/l |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 200 MPN/100 ml |
| Temperature | 95°F. |

The segment receives a portion of the discharge from subbasin 41. Discharges within the subbasin to this segment are 413 lbs./day BOD and 444 lbs./day TSS with a wastewater discharge rate of 3.8 MGD. Projected 1995 wasteloads total 382 lbs./day BOD and 576 lbs./day TSS. Review of water quality data indicates that no violations of the state water quality standards have occurred. For this reason, this segment has not been designated as a problem area. Table III-19 presents existing and projected wastewater discharges to this segment.

## TABLE III-19

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

**SEGMENT 2426**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | 0.02 | 3.8 | 3.8 |
| $BOD_5$ (lb./day) | 2 | 411 | 413 |
| TSS (lb./day) | 4 | 440 | 444 |
| **1983** | | | |
| Flow (MGD) | 0.1 | 4.1 | 4.2 |
| $BOD_5$ (lb./day) | 4 | 339 | 343 |
| TSS (lb./day) | 6 | 508 | 514 |
| **1990** | | | |
| Flow (MGD) | 0.1 | 4.3 | 4.4 |
| $BOD_5$ (lb./day) | 5 | 361 | 366 |
| TSS (lb./day) | 9 | 542 | 551 |
| **1995** | | | |
| Flow (MGD) | 0.1 | 4.5 | 4.6 |
| $BOD_5$ (lb./day) | 5 | 377 | 382 |
| TSS (lb./day) | 10 | 566 | 576 |

**Number of Recorded Violations***

| | |
|---|---|
| D.O. (mg/l) | -- |
| pH | -- |
| Fecal Coliform (MPN/100 ml) | -- |
| Temp. (°F.) | -- |
| Chloride (mg/l) | -- |
| Sulfate (mg/l) | -- |
| TDS (mg/l) | -- |

* From Water Quality Management Plan for the San Jacinto Basin, Texas Water Quality Board, Draft Report, 1976.

## Segment 2427

Segment 2427 is known as the San Jacinto Bay. The water uses TWQB has established for the segment are contact and non-contact recreation and propagation of fish and wildlife. The following water quality standards have been established for the segment:

| | |
|---|---|
| D.O. | 4.0 mg/l |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 200 MPN/100 ml |
| Temperature | 95°F. |

The segment receives a portion of the discharge from subbasin 40. Discharges within the subbasin to this segment are 1273 lbs./day BOD and 1666 lbs./day TSS with a wastewater discharge rate of 9.4. Projected 1995 wasteloads total 5,254 lbs./day BOD and 11,733 lbs./day TSS.

Review of TWQB water quality data indicates that the existing water quality of this segment is generally good. However, the large increases in industrial wastes which have been projected may lead to water quality problems. Since the current water quality of the segment is considered good, the segment has not been designated a water quality problem area. However, the segment should be closely watched to assure that projected increases in waste discharges do not adversely impair the ability of the segment to meet the established standards. Table III-20 presents existing and projected wastewater discharges to this segment.

## TABLE III-20

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

### SEGMENT 2427

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | 9.4 | 0.0 | 9.4 |
| $BOD_5$ (lb./day) | 1,272 | 1 | 1,273 |
| TSS (lb./day) | 1,665 | 1 | 1,666 |
| **1983** | | | |
| Flow (MGD) | 32.8 | 0.0 | 32.8 |
| $BOD_5$ (lb./day) | 1,366 | 0 | 1,366 |
| TSS (lb./day) | 2,321 | 1 | 2,322 |
| **1990** | | | |
| Flow (MGD) | 84.5 | 0.0 | 84.5 |
| $BOD_5$ (lb./day) | 3,097 | 0 | 3,097 |
| TSS (lb./day) | 6,365 | 1 | 6,366 |
| **1995** | | | |
| Flow (MGD) | 151.8 | -- | 151.8 |
| $BOD_5$ (lb./day) | 5,254 | -- | 5,254 |
| TSS (lb./day) | 11,733 | -- | 11,733 |

**Number of Recorded Violations***

| | |
|---|---|
| D.O. (mg/l) | -- |
| pH | -- |
| Fecal Coliform (MPN/100 ml) | -- |
| Temp. (°F.) | -- |
| Chloride (mg/l) | -- |
| Sulfate (mg/l) | -- |
| TDS (mg/l) | -- |

* From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 2428

Segment 2428 is known as Black Duck Bay. The water uses TWQB has established for this segment are contact recreation, non-contact recreation, and propagation of fish and wildlife. The following water quality standards have been set for the segment:

| | |
|---|---|
| D.O. | 4.0 mg/l |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 200 MPN/100 ml |
| Temperature | 95°F. |

The segment receives no industrial or municipal waste discharges. Review of TWQB water quality data indicates that the state water quality standards for pH are frequently violated. However, since there are no current or projected point source discharges to this segment, these violations are assumed to be attributable to other sources, and this segment has not been designated as a water quality problem area.

## Segment 2429

Segment 2429 is known as Scott Bay. The water uses TWQB has established for this segment are contact recreation, non-contact recreation, and propagation of fish and wildlife. The following water quality standards have been set for the segment:

| | |
|---|---|
| D.O. | 4.0 mg/l |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 200 MPN/100 ml |
| Temperature | 95°F. |

The segment receives a portion of the discharge from subbasin 41. Current (1975) discharges within subbasin 41 to segment 2429 are 51 lbs./day BOD and 78 lbs./day TSS with a wastewater discharge rate of 0.7 MGD. Projected 1995 wasteloads total 123 lbs./day BOD and 236 lbs./day TSS.

Review of TWQB water quality data indicates that the water quality of this segment is generally good. Moderate industrial growth and expected implementation of point source control technologies should prevent significant degradation of the current water quality of this segment. Therefore, it has not been designated as a water quality problem area. Table III-21 presents existing and projected wastewater discharges to this segment.

## TABLE III-21

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

**SEGMENT 2429**

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | 0.7 | -- | 0.7 |
| BOD$_5$ (lb./day) | 51 | -- | 51 |
| TSS (lb./day) | 78 | -- | 78 |
| **1983** | | | |
| Flow (MGD) | 1.9 | -- | 1.9 |
| BOD$_5$ (lb./day) | 84 | -- | 84 |
| TSS (lb./day) | 140 | -- | 140 |
| **1990** | | | |
| Flow (MGD) | 2.6 | -- | 2.6 |
| BOD$_5$ (lb./day) | 110 | -- | 110 |
| TSS (lb./day) | 204 | -- | 204 |
| **1995** | | | |
| Flow (MGD) | 3.0 | -- | 3.0 |
| BOD$_5$ (lb./day) | 123 | -- | 123 |
| TSS (lb./day) | 236 | -- | 236 |

**Number of Recorded Violations***

| | |
|---|---|
| D.O. (mg/l) | -- |
| pH | 1 |
| Fecal Coliform (MPN/100 ml) | -- |
| Temp. ($^{o}$F.) | -- |
| Chloride (mg/l) | -- |
| Sulfate (mg/l) | -- |
| TDS (mg/l) | -- |

* From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 2430

Segment 2430 is known as Burnett Bay. The water uses TWQB has established for this segment are contact recreation, non-contact recreation, and propagation of fish and wildlife. The following water quality standards have been set for the segment:

| | |
|---|---|
| D.O. | 4.0 mg/l |
| pH | 6.5 to 8.5 |
| Fecal Coliform | 200 MPN/100 ml |
| Temperature | $95^{\circ}$F. |

This segment receives a portion of the wastewater discharge from subbasin 41. Current (1975) total industrial and municipal discharges for the segment are 101 lbs./day BOD and 112 lbs./day TSS with a wastewater discharge rate of 0.9 MGD. Projected 1995 wasteloads total 71 lbs./day BOD and 106 lbs./day TSS.

Review of TWQB water quality data indicates that the state water quality standards for pH are occasionally exceeded. Since there are no industrial discharges to this segment, and since other segments in the general vicinity indicate naturally high pH levels, these occasional high values are assumed to be due to causes other than point sources. Since wasteload discharges are projected to decline for this segment, it has not been designated a water quality problem area. Table III-22 presents existing and projected wastewater discharges to this segment.

## TABLE III-22

## SEGMENT SUMMARY OF PROJECTED WASTELOADS AND WATER QUALITY

### SEGMENT 2430

| | Industrial | Municipal | Total |
|---|---|---|---|
| **1975** | | | |
| Flow (MGD) | -- | 0.9 | 0.9 |
| $BOD_5$ (lb./day) | -- | 101 | 101 |
| TSS (lb./day) | -- | 112 | 112 |
| **1983** | | | |
| Flow (MGD) | -- | 0.9 | 0.9 |
| $BOD_5$ (lb./day) | -- | 71 | 71 |
| TSS (lb./day) | -- | 106 | 106 |
| **1990** | | | |
| Flow (MGD) | -- | 0.9 | 0.9 |
| $BOD_5$ (lb./day) | -- | 71 | 71 |
| TSS (lb./day) | -- | 107 | 107 |
| **1995** | | | |
| Flow (MGD) | -- | 0.9 | 0.9 |
| $BOD_5$ (lb./day) | -- | 71 | 71 |
| TSS (lb./day) | -- | 106 | 106 |

### Number of Recorded Violations*

| | |
|---|---|
| D.O. (mg/1) | -- |
| pH | 4 |
| Fecal Coliform (MPN/100 ml) | -- |
| Temp. (°F.) | -- |
| Chloride (mg/1) | -- |
| Sulfate (mg/1) | -- |
| TDS (mg/1) | -- |

* From Texas Water Quality Board Statewide Monitoring Network: Sampling Data Inventory, January 1973 through December 1976, unless otherwise noted.

## Segment 2436

Segment 2436 is known as Barbours Cut. The water uses TWQB has established for this segment are contact and non-contact recreation. The following water quality standards have been set for the segment:

| | |
|---|---|
| D.O. | 4.0 mg/1 |
| pH | 6.0 to 9.0 |
| Fecal Coliform | 200 MPN/100 ml |
| Temperature | 95°F. |

The segment receives no municipal or industrial discharges and is not projected to receive any waste discharges through 1995. The San Jacinto River Basin Plan (1975) indicates that this segment is in compliance with the established standards. Since both municipal and industrial growth in this segment appears to be limited, it has not been designated a water quality problem area.

## Segment 2438

Segment 2438 is the Bayport Ship Channel. The water use TWQB has established for this segment is non-contact recreation. The following water quality standards have been set for the segment:

| | |
|---|---|
| D.O. | 4.0 |
| pH | 6.0 to 9.0 |
| Fecal Coliform | 1,000 MPN/100 ml |
| Temperature | 95°F. |

A wasteload evaluation of the segment, as well as the San Jacinto River Basin Plan (1975), indicates that the segment's quality is generally good. The segment currently receives no municipal or industrial waste discharges and is not projected to receive any waste discharges through 1995. In view of this, the segment has not been designated a water quality problem area.

## Summary

Review of the existing water quality and existing and projected wasteloads by stream segment and comparison to stream segment standards has been accomplished in this chapter. The result has been to identify certain stream segments which are not expected to meet stream segment water quality standards in the future and identify them as water quality problem areas.

The stream segments so identified are listed below:

0901
1004
1005
1006
1007
1009
1102
1103
1104
2421

# APPENDIX A

# INDUSTRIAL WASTELOAD PROJECTION METHODOLOGY

# FOREWORD

The industrial wasteload projection methodology assumes the Environmental Protection Agency will not rescind specific guidelines. However, this has occurred in certain industries and should be considered when using this data.

## INDUSTRIAL WASTELOAD PROJECTIONS METHODOLOGY

### Introduction

The projection of industrial wasteloads has been accomplished by application of an Industrial Wasteload Projection Model. The model projects wasteloads by standard industrial classification (SIC) and by subbasin as defined in Chapter I. The model has been designed for computer application utilizing the industrial point source inventory described in Chapter I. The following discussion of the Industrial Wasteload Projection Model is subdivided into inputs, assumptions, procedures, and outputs.

### Inputs

Input to the model includes current industrial discharge wasteloads, industrial discharge wasteloads under Best Practicable Control Technology (BPCT) regulatory conditions, industrial land use projections, OBERS Series E projections of industrial production, the ratio of the Best Available Control Technology (BAT) to BPCT, projection years, implementation year for the regulatory levels of BPCT and BAT, and a factor which corrects projected discharges to account for industrial discharges to municipal systems.

#### Wasteload Data Base

The wasteload data base was developed to serve as input to the model. It was compiled from the point source inventory of industrial wastewater dischargers. The data base was compiled for each subbasin by SIC group and reflects BPCT regulatory conditions. Discharge levels equal to 1977 permit limits were assumed equal to BPCT regulatory conditions. To assure a complete listing, present permit limits and self-reporting data were used as alternate sources of 1977 (BPCT) data.

All dischargers to municipal collection and treatment systems were excluded to avoid double counting of those dischargers. Storm water dischargers were eliminated from the projection, as well as other inputs which were not consistent with a projection of average daily wasteloads attributable to production activities.

The data base developed in this manner serves as input to the model. It should be noted that the data base represents permitted discharge values rather than actual discharge values. Actual discharge values may be expected to vary from these permitted values.

## Industrial Land Use

Land use projections were prepared by the Houston-Galveston Area Council. These projections were initially aggregated by census tracts. To be useful in the industrial wasteload projection model, projections of industrial land use by subbasin were required, and H-GAC revised the land use projections to provide information in the appropriate format. Industrial land use data was presented in acres by subbasin and serves as a primary input to the model.

## Industrial Production Projections

Projections of industrial production for the period under consideration are available from the U. S. Water Resources Council, Washington, D.C. The projections are of regional economic activity in the U. S. and are known as OBERS Projections, Series E, Population. Volume V of this series presents industrial earnings projections for standard metropolitan statistical areas (SMSA). These earnings projections were converted to projections of production using factors provided in Volume I of the OBERS series. Should other projections of industrial activity be used in the future, careful review of the input data is required. The adjusted earnings data is presented by industry category which corresponds to two-digit standard industrial classification (SIC) codes to indicate changes in the level of industrial activity in the planning area.

## Regulatory Requirements

Information for compiling the ratios of BAT to BPCT was obtained from the "Summary of Final Effluent Limitations Guidelines for Existing Sources and Standards of Performance for New Sources" published by the Environmental Protection Agency (EPA), Office of Enforcement. The average daily limits for BPCT and BAT for each SIC classification was taken to formulate the BAT/BPCT ratio for each industry group. For those industries which have zero discharge of wastewater pollutants indicated, the BAT/BPCT ratio has been set equal to zero. For those industries where no effluent limitation guideline has been established, the ratio has been set equal to one.

## Industrial Discharges to Municipal Systems

The wasteload projection model includes an adjustment factor which accounts for industries discharging to municipal systems. Currently, information of sufficient detail to allow meaningful use of this factor is not available, and it has been set equal to unity. Although not significant in these projections, the inclusion of this factor for later definition and incorporation is a significant feature of the model.

## Substitution of Data

The Industrial Wasteload Projection Model has been developed to allow maximum flexibility when selecting input data. The model will accept inputs for industrial activity and industrial land use between any specified years. The model will interpolate the input values to obtain data for the interim projection years as specified in the input. Projection years may be changed to incorporate new data, and the date of implementation of BAT regulations may be designated. However, the discharge levels of the data base must be equivalent to BPCT regulatory conditions.

# Assumptions

The form of the model and the nature of the input data are based on certain inherent assumptions. The following discussion will define the major assumptions implicit to the model so that the user may better understand its limitations.

## Input Data

Several assumptions are inherent to the projection model as a result of the selected input data. The BPCT data base has been compiled from future permitted values. In the absence of future permit values, it has been assumed that present permit values are equal to BPCT. In a few instances where neither future nor present permit values are available, it has been assumed that current self-reporting data is equal to the 1977 permit value. It has also been assumed that regulatory requirements of BPCT are equal to future (1977) permit levels. This assumption is justified partly by the observed cooperation established between TWQB and EPA in the permitting process. The elimination of storm water discharges from the projection data assumes that these discharges will not vary with growth in production or with regulatory changes.

The use of H-GAC land use data requires adoption of the assumptions made for developing those projections, and their implementation requires the assumption that changes in industrial wasteloads within a subbasin are proportional to changes in industrial land use within that subbasin. Additionally, it has been assumed that the increase in wasteloads within each subbasin will be distributed among those SIC groups currently existing within that subbasin.

It has been assumed that industrial processing will generate pollutants in the planning area in proportion to the number of units of product produced and that changes in the number of units produced is best approximated by the change in adjusted earnings projected by OBERS, Series E.

The use of unity as the factor accounting for industrial discharge to municipal systems requires the assumption that the percentage of industrial discharges to the municipal system remains constant throughout the projection period. Since only limited data is available concerning these discharges, the factor has not been dimensioned, nor has it been related to other parameters of the model such as SIC's or subbasins. Thus, the factor has been recognized and included in the model to allow flexibility for future development of data to support its use.

Finally, it is assumed that specific regulatory levels are fully implemented at the start of the year in which implementation is projected.

Although some assumptions are limiting and are in need of additional studies for verification, it is believed that they provide a reasonable basis for projecting future changes in wasteloads. Incorporation of new input data should be carefully reviewed to assure that it is consistent with the assumptions of the model.

It is significant to note that flow, BOD, and TSS are projected from separate baseline data. That is, there is no direct relationship in the model between these parameters. This is a significant feature of the model since it avoids basing the projections of BOD and TSS on the projection of flow by assuming a specific concentration of pollutant. Concentration-based projections are difficult because increased water conservation practices are likely to be implemented. This would change flow volume and concentration but might not affect total wasteload. BOD and TSS parameters are based on estimated production and EPA regulatory levels, and no specific relationship between flow and the other parameters need be identified.

## Procedures

The procedure for implementing the model is first to provide the necessary input data and formulate the base data matrix. The matrix is compiled in order to store values for changes in industrial land use by subbasin, OBERS growth multipliers, and other input data.

OBERS projections of production are used to calculate total growth and change in growth for each SIC group in the planning area. The ratio of change in discharges within a subbasin to total change in discharge is then calculated for each SIC. With this data, a growth factor is calculated for each subbasin. The calculation of the growth factors will be performed within one SIC group for each subbasin within the study area. The growth factor is checked for consistency and adjusted, if necessary, to assure that all projected wasteload for the SIC is distributed. Once this has been accomplished, the projection formula may be employed. This formula is:

$$W_{i,j,t+1} = W_{i,j,t} + \Delta W_{i,t \text{ to } (t+1)} (G)(F)$$

where:

W = Wasteload
G = The adjusted growth factor
F = A factor to allow correction for industrial wasteloads discharging to municipal sewers

and the subscripts i, j, and t are used to:

1) designate an SIC group (i),
2) designate a subbasin (j), and
3) designate a time (t).

This formula is applied to all subbasins for each SIC. After the wasteload for a given SIC has been distributed, the procedure is applied to the next SIC until the entire areawide industrial wasteload has been distributed between SIC groups and subbasins for that year.

Input data will specify the year in which BAT regulatory requirements will become effective. To account for the regulatory change, wasteload projections are first calculated in the normal manner and then the appropriate BAT/BPCT ratios are used to convert these wasteloads from BPCT to BAT.

## Outputs

The model presents the projections in three tabular formats. The first table presents projected wasteloads by subbasin and SIC, the second by SIC, and the third by subbasin. Totals are presented for each format.

Flows are presented as millions of gallons per day (MGD). Five-day Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) are presented as pounds per day. These data are totalled over the entire 208 area at the end of each table. Slight differences in these totals are a result of rounding.

The years chosen for implementation of BPCT and BAT regulatory levels are indicated at the top of each page to assist identification of a particular projection. Industrial wasteload projections with BPCT effective in 1977 and BAT effective in 1983 are available in printout form at the H-GAC.

# APPENDIX B

## MUNICIPAL WASTELOAD PROJECTION METHODOLOGY

# MUNICIPAL WASTELOAD PROJECTION METHODOLOGY

## INTRODUCTION

The Municipal Wasteload Projection Model has been developed specifically to assist the Point Source Analysis (PSA) contractor in defining and locating existing and future water quality problems associated with municipal wastewater treatment facilities. A separate projection methodology has been developed for Industrial Wasteload Projections, and the two will be used to define and locate overall Point Source pbolems. The municipal wasteload methodology has been programmed and stored in the H-GAC computer. This will allow for updating based on population, land use, and employment changes, insuring a continuing planning process as the Greater Houston 208 Area grows and changes.

Input data to the Municipal Wasteload Projection program includes population and land use numbers, service area boundaries, Federal and State effluent limitations and State self-reporting information. This data proceeds through a series of calculations which compute flows and wasteloads for Biochemical Oxygen Demand (BOD) and Total Suspended Solids (TSS) for 1975 and 1995. A straight line interpolation is then used to determine flows and loads for 1983 and 1990.

A refinement of this model is currently underway at H-GAC, which will allow a more accurate definition of interim changes in wasteloads. This refinement has no bearing on work being done by the PSA consultant, and its mention here is strictly informational in nature.

This methodology is sufficiently flexible to incorporate changes in the coefficients for domestic ($c_1$), employment ($c_2$), commercial ($c_3$), and industrial ($c_4$) contributions to municipal wasteloads as area specific data is developed and verified. The municipal wasteload projection methodology was developed with the intent of providing for updates as new data are developed.

Input data for the Municipal Wasteload Projection Model is as follows:

1. 1975, 1980, 1983, 1985, 1990, and 1995 land use total in acres by census tract.
2. 1975, 1980, 1983, 1985, 1990, and 1995 population totals by census tract.
3. 1973 employment levels by census tract.

4. **Wasteload treatment plant locations and permit numbers by service area.**

5. **1975 TWQB self-reporting data.**

6. **1975 land use in acres by census tract by service area.**

7. **1995 land use in areas by census tract by service area.**

**The methodology employed by the model to project wasteloads is outlined below:**

**Computation of Service Area Population & Land Use**

$$P_{sa} = \sum_{ct} P_{ct} \left( \frac{SF_{sa,ct} + 3 \times MF_{sa,ct}}{SF_{ct} + 3 \times MF_{ct}} \right)$$

$$E_{sa} = \sum_{ct} E_{ct} \left( \frac{CO_{sa,ct} + 2 \times IN_{sa,ct}}{OC_{ct} + 2 \times IN_{ct}} \right)$$

$$SF_{sa} = \sum_{ct} SF_{sa,ct}$$

$$MF_{sa} = \sum_{ct} MF_{sa,ct}$$

$$CO_{sa} = \sum_{ct} CO_{sa,ct}$$

$$IN_{sa} = \sum_{ct} IN_{sa,ct}$$

**Where:**

$\sum_{ct}$ = **To sum over all census tracts which contain part of the service area in question.**

$P_{sa}$ = **Population in each service area.**

$E_{sa}$ = **Employment for each service area.**

$SF_{sa}$ = **Single Family acreage in each service area.**

$MF_{sa}$ = **Multi-Family acreage in each service area.**

$CO_{sa}$ = **Commercial acreage in each service area.**

$IN_{sa}$ = **Industrial acreage in each service area.**

$P_{ct}$ = Total population in each census tract.

$E_{ct}$ = Total employment in each census tract.

$SF_{sa,ct}$ = Single Family acreage within a service area in each census tract.

$MF_{sa,ct}$ = Multi-Family acreage within a service area in each census tract.

$CO_{sa,ct}$ = Commercial acreage within a service area in each census tract.

$IN_{sa,ct}$ = Industrial acreage within a service area in each census tract.

Once the total population employment numbers and commerical and industrial land use have been calculated for each service area, the following computation is used to determine the flows for each service area:

$$F_{sa} + C_1 \times P_{sa} + C_2 \times E_{sa} + C_3 \times CO_{sa} + C_4 \times IN_{sa}$$

Where:

$F_{sa}$ = Fow from service area.

$C_1$ = 100 gal./person/day.

$C_2$ = 25 gal./employee/day.

$C_3$ = 500 gal./acre/day.

$C_4$ = 1,000 gal./acre/day.

Then, for each service area:

$LB/D_B = F_{sa} \times 8.34 \times \text{Conc.}_B$

$LB/D_S = F_{sa} \times 8.34 \times \text{Conc.}_S$

Where:

$LB/D_B$ = Pounds per day biochemical oxygen demand.

$LB/D_S$ = Pounds per day total suspended solids.

## OUTPUTS

Output data from the Municipal Wasteload Projection Model is as follows:

A computer printout listing flows and loads by service area and wastewater treatment plant waste control order numbers where available for the years 1975, 1983, 1990, and 1995. This printout is available at the Houston-Galveston Area Council.

Total flows and loads for the Greater Houston 208 Area are listed for each of the four planning years noted above.

Flows are recorded in million galloss per day (MGD), and wasteloads in pounds per day (LB/D) of BOD and TSS.